METAL INDUSTRY

VOLUME 93 NUMBER 3 18 JULY 1958

International Standards

HARROGATE was the venue for the recently held fourth plenary session of the International Organization for Standardization to which nearly 1,000 delegates from almost every country in the world which engages in foreign trade had travelled. All fifteen of the technical committees had their successes to report to the conference and an impressive number of ISO "recommendations" which are, in effect, international standards, were brought to completion or near-completion. Delegates from the United Kingdom numbered close on 150 and included many noted personalities from those industries with a direct interest in the various committees meeting at Harrogate.

Of particular interest to the non-ferrous metals industry were the recommendations of technical committee number 26—copper and alloys. This committee agreed on three proposed ISO recommendations as follows:—methods of test for residual (internal) stress of copper and copper base alloys (mercurous nitrate test); methods of test for expansion of copper and copper alloy tubing (pin test), and classification of raw copper. Important progress was made in drawing up two basic classifications, one for wrought copper and copper alloys, and the other for cast copper alloys, which include the chemical composition and mechanical properties of the alloys. Delegates gave their preliminary approval to a draft specification for electrolytic copper wire bar, cakes, slabs, billets, ingots and ingot bars. This specification together with further methods of mechanical test will be sent to the member-countries of the ISO for their approval or comments. Among new projects to be tackled by working groups are:—tensile test for sheet and strip of thickness less than 0·5 mm.; tensile test for wire of diameter less than 5 mm.; tensile test for tubes; wrapping test for tubes; reversed bend test for sheet and wire; simple torsion test; and flattening test for tubes.

The other report of interest was that provided by technical committee number 79—light metals and their alloys. This committee had prepared recommendations relating to magnesium ingots and magnesium alloy ingots and castings; other recommendations for pure aluminium, aluminium alloy castings and tensile and hardness testing of light alloys which are also at an advanced stage. The delegates reached agreement on international standards covering: (1) composition of magnesium zirconium alloy castings; (2) composition of four additional aluminium alloy castings; (3) composition of wrought aluminium and aluminium alloys; and (4) unalloyed magnesium conventionally defined as 99·95.

The growing activities of the ISO were outlined by the retiring President, Sir Roger Duncalfe, in his address to the assembly in which he said that the striking feature of the technical work of the organization was the increasing rate at which draft recommendations were coming forward, and the need to see that they were transformed with the least possible delay into published recommendations and made available to those industries of the world which most needed them.

Out of the MELTING POT

Coming Nearer

WHILE the method of depositing coatings by applying a potential difference to a dispersion of the coating material in a liquid was still being referred to as electrophoretic coating, it could conveniently be dismissed as something a little out of the practical world, and comparisons between it and electroplating as too far-fetched. There may now be some inclination to modify such views following the introduction of a process for forming coatings of polytetrafluoroethylene (P.T.F.E.) resin, which process, although it still depends on electrophoresis, has been launched, will no doubt live on, and will henceforth be commonly referred to as an electroplating process, the resulting coatings being correspondingly, and without any immediately obvious prevarication, being called electroplates or electrodeposited coatings. With the change in name has come the first comparison with electroplated coatings. This shows that because of the difference in the ratio of charge to particle size, one Faraday (96,000 amp/sec.) will deposit 20,000 to 50,000 gm. of the P.T.F.E. as compared with only 31·8 gm. of copper or 32·7 gm. of zinc from conventional ionic plating baths. Instead of dismissing such a comparison as irrelevant, it could, more usefully, be allowed to lead to fanciful or not so fanciful visions of plating processes in which at least some of the deposited metal would not have been carried through the process of conversion to the ionic state and then back again to the atomic form in the final deposit. Could not some metal be derived from a colloidal suspension (possibly prepared from the anode by Bredig's method), from a directly applied sufficiently fine metal powder, from a chemical reduction of the dissolved metal, or some other source? Coming back to the electroplating of P.T.F.E., it must be admitted that a closer look at the details of the process shows that it is not as simple as simple electroplating. The suspension has to contain a film-forming substance for temporarily holding the deposited particles of resin, the deposition occurs on the anode, treatment of the suspension with ion exchange resin to control acidity is advisable, and the deposit has to be dried, and finally sintered at 300°-500°C. Nevertheless, so far as electroplating is concerned, this new process should be given careful consideration as a competitor, ally, or as a pointer to developments yet to come.

Wrong Hump

AT this season of the year, more than one examination candidate, if unfortunately unsuccessful, could derive some slight consolation from a short article on the distribution of scores in examinations of finite length. The consolation would be derived from the fact that, as the article explains, it is, in certain circumstances, possible justifiably to attribute some of the blame for failures to the examiners. Briefly, in this article a transformation from the distribution of the students' knowledge to the distribution of examination scores is derived, based on some simple definitions and assumptions. Naturally, nothing can be said about whether a particular student's score (in an examination with a finite number of questions) reflects his knowledge accurately, since he may have been lucky enough to have been asked just what he knew, or conversely. Average results for a sufficiently large number of candidates can be evaluated, however. The conclusion arrived at, is that the distribution of scores may be a severely distorted version of the distribution of knowledge (Hear! hear!). In particular, a disproportionately large number of questions at a certain level of difficulty can produce a corresponding minimum in the distribution of scores, so that spurious humps or peaks may be introduced by the choice of examination questions. For the benefit of examiners setting questions, mention must also be made of the conclusion that, in setting examination questions, an effort should be made to include a uniform distribution of questions from easy to hard, because this is the distribution which introduces no distortion.

Incomplete

LIMITATIONS imposed by the length of the paragraphs on this page are usually of no great import on occasions when the gist of some new invention described at great length in a patent specification is to be presented. In the case of two recent patents, however, although the main claims can be given, it is impossible to go to the lengths which alone would be able to do full justice to the inventions. The first of these is concerned with improvements in the production of flaky powders. These, it is pointed out, have hitherto been obtained either by rolling granulated material between hard metal rolls, or by tamping in large mortars, as is usual in the bronze paint industry. This process of manufacture is very cumbersome and also costly. According to the invention, flaky powders are prepared by milling a non-flaky granulated material in a ball mill or oscillator mill in the presence of up to 10 per cent (preferably 0·1 to 5 per cent) by weight of a volatile liquid which is inert towards the granulated material. Milling is continued for not more than 20 hr. and preferably not more than 10 hr. Flaky powders of aluminium, copper or tin can be prepared in this way. Methanol, ethanol, propanol, isopropanol, carbon tetrachloride, petroleum, benzene or toluene can be used as the volatile liquid. A lubricant such as paraffin, a stearine or a silicone may be added to the liquid. The process, according to the above invention, is claimed not to cause any substantial change in the screen analysis of the powder, whereas the known processes substantially increase the proportion of fine particles at the expense of the coarse particles. Manufacturers of aluminium paste will certainly wish to look further into this matter. The second invention to which, in these days of improved soldering and brazing techniques and of inert gas, arc, pressure, ultrasonic and other modern methods of welding aluminium, it might yet on occasion be found advisable to turn, is concerned with an aluminothermic method of cast welding such objects as aluminium conductors to one another, or an aluminium conductor to, for example, a copper bus bar. The exothermic mixture consists essentially of tin (stannic) oxide, aluminium powder and calcium fluoride, with possible additions of cuprous oxide and a powder or powders of such metals as nickel, silver, iron, and chromium. The effectiveness of the process depends in particular on the weld metal (tin or tin alloy) being heated by the exothermic reaction to not less than 2,000°F.

Skimmer

Pressure Die-Casting Review

Design of Die-Castings

VIII—Designing Die-Castings for Easy Finishing

By H. K. BARTON

AS his first concern, the designer of a die-cast component clearly must have the efficient functioning of the product in mind. This imposes limitations upon the shape, wall thickness and so on, but, even so, a considerable freedom can generally be exercised in arriving at the detailed form of the part. Within this limited field of choice, the precise form of the minor features of the component—and, often, their location—should be determined with regard to the complexity of the die mechanisms needed to produce it. In perhaps a majority of instances this latter requirement does not, in effect, impose any limitation at all, for very many die-castings are of so simple a form that they can readily be produced from a single simple two-part die. It is often the case that the disposition of the cavity between the die members—from the component designer's point of view, the position of the parting-line on the component—is predetermined by the very nature of the casting: the simpler the form of the part, the more likely is this to be so.

Thus the two simple forms of Fig. 1 (*a*), a shallow tapered cylinder and a cross with the arms in different planes, can only have in practice the flash-planes indicated by the arrows, whereas the very similar components at *b* can, if adequate draft is allowable, have their parting-lines disposed anywhere at right angles to the vertical faces. The components of either pair, that at *a* or that at *b*, thus represent the same problem so far as cavity disposition is concerned, despite the disparity of form between disc and cross.

In one respect, however, the disc and cross differ radically, whatever parting-plane be chosen; this is with regard to ease of trimming. It is obviously simpler to construct a trimming tool for the circular profile than for the cruciform one, whilst the actual placing of the component in position for trimming may also be easier, though this is not necessarily so since location in the tool is often achieved by registers forming part of runner or sprue. Further, even when flash is not trimmed by positive means, but is removed in a barrelling operation, the disc is still easier to finish than the cross.

These two very dissimilar forms have been taken as an example because it might appear at first that they could not possibly provide alternative forms for the same component. This is, in fact, not the case, but it appears to be so, because there is nothing more difficult for the designer to do than to divorce function entirely from form. Almost every potential die-casting reaches the designer as a sketch or a prototype, rather than as a specification for certain functions to be performed, and it is very hard not to take the original form as the basis for the die-casting, merely modifying it in detail.

Thus, as a practical analogue of the cross-shaped piece already discussed, the bell-crank lever illustrated in Fig. 2 may be taken. In making this (or rather the wooden prototype) the simplest construction has been followed; the arms are of rectangular section glued together at the junction, and the ends of the arms are shaped to the profile of the terminal bosses. The shape of the part is simple and, indeed, may seem ideally suited to its purpose. The likelihood is that the designer will accept it as such, merely indicating on the drawing the draft that is required. The position of the die parting is for all practical purposes fixed, one arm being formed in each of the die members.

In point of fact, the design shown is by no means an inevitable choice and for a die-cast component is, despite its apparent simplicity, not necessarily the best. Functionally, the component resolves to the elements depicted in Fig. 3; two bores of differing diameters, one peg to take a spring and one oscillating flat face, which are fixed in a three-dimensional co-ordinate frame but can be rigidly united in any suitable way. To conceive of the part as necessarily consisting of a pair of levers which, by die-casting, can be integrally formed instead of being joined together as in the prototype, is to throw away the main advantages of the process.

The possible ways in which the functional elements of Fig. 3 can be embodied in a die-casting are virtually infinite, and as an illustration one may be chosen which is not only far removed from the prototype in Fig. 2, but has salient merits of its own, both as a functioning component and as a die-casting. This is shown in Fig. 4 and is of circular outline, so that the simplest possible trimming tool can be employed. The annular peripheral wall is formed half in each die member, so that the parting line is disposed as indicated, and the inner face of the wall is formed by a core member mounted in one or other of the die-blocks. The faces of these cores are milled away in alternate sectors, thus forming a pair of cells on each side of the component.

The actual functioning elements are

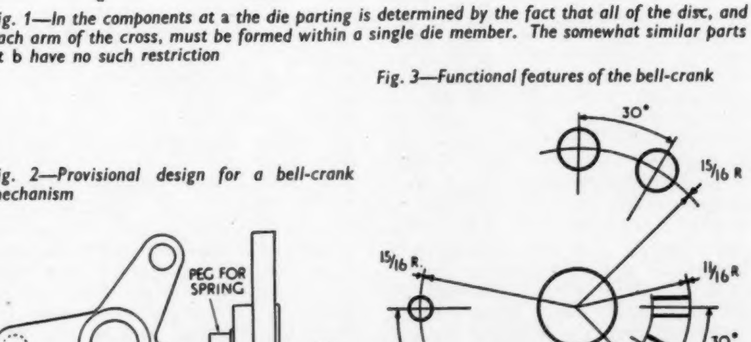


Fig. 1—In the components at a the die parting is determined by the fact that all of the disc, and each arm of the cross, must be formed within a single die member. The somewhat similar parts at b have no such restriction

Fig. 2—Provisional design for a bell-crank mechanism

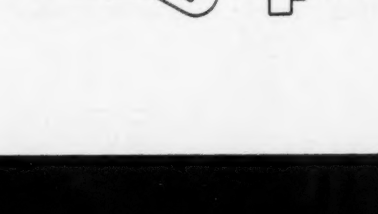
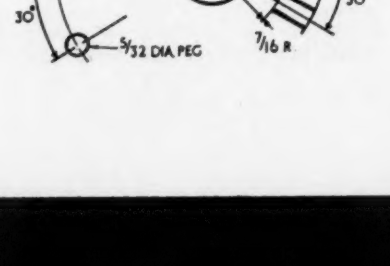
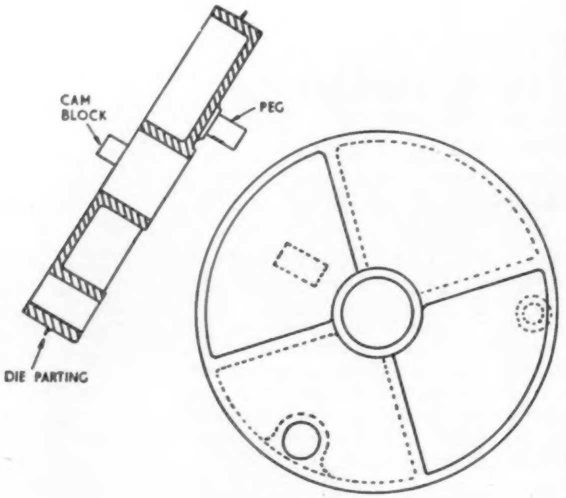
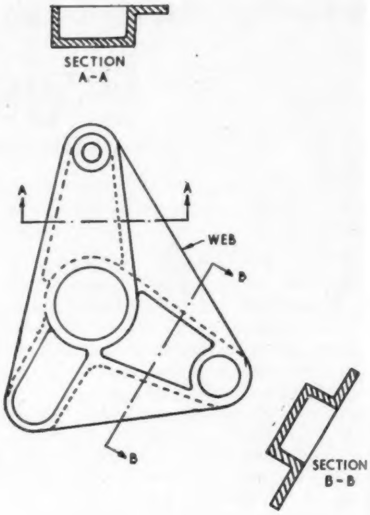


Fig. 3—Functional features of the bell-crank





Left: Fig. 4—Here a thin-walled circular web carries the functioning elements



Right: Fig. 6—An alternative design with hollowed arms and a stiffening web

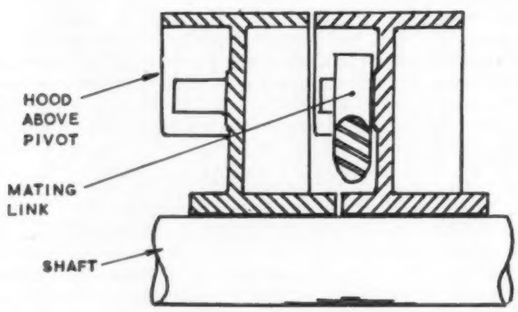


Fig. 5—Part section showing hoods above the pivot pins as a safety measure in exposed mechanisms

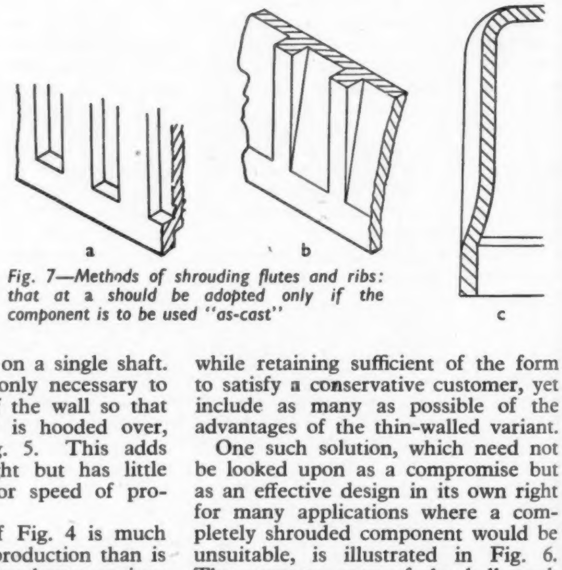


Fig. 7—Methods of shrouding flutes and ribs: that at a should be adopted only if the component is to be used "as-cast"

incorporated in three bosses and a short rib projecting from thin walls of the cells at appropriate positions, the bores being formed by small cores set in the main cores. Inspection of the sketch will show that many minor variants on this basic design are possible; thus, for example, the web might have been placed in the plane of the parting and the septa between the cells replaced by ribs. The method indicated, however, is likely, on the whole, to give a sounder and better-surfaced casting than conventional web-and-rib designs.

The functional advantage of the construction shown, when applied to a component that, in operation, rocks through an angle of 30°, as indicated in Fig. 3, is that it very greatly reduces the possibility of accidental damage should anything — a spanner, for example—be dropped into the moving mechanism. The peripheral wall being of circular form, jamming is less likely to occur than with the bell-crank of Fig. 2 and similar forms, where anything falling into the mechanism is very likely to foul one of the arms.

It is still possible, of course, for interference to take place between some extraneous object and the projecting bosses of the links attached to them, but this only becomes a probability when several such components are closely mounted on a single shaft. To meet this, it is only necessary to extend one sector of the wall so that the whole assembly is hooded over, as indicated in Fig. 5. This adds slightly to the weight but has little effect on the ease or speed of production.

The component of Fig. 4 is much more suited to fast production than is that of Fig. 2, which has heavy sections that do not chill rapidly. Additionally, the thin-walled component is much stronger, weight for weight, and is not subject to porosity—as is the heavy-armed bell-crank. The mean wall thickness is in the region of 0·050 in., as opposed to 0·180 in. in the bell-crank. The webs and septa have a minimum thickness of only 0·040 in., though this particular dimension is likely to be increased by from 0·003 in. to 0·005 in. when the tool is in normal operation.

Such a radical departure from an existing form may sometimes be looked at askance, even though its functional effectiveness is indisputable. This does not necessarily mean that one must revert to the form of the prototype; as already noted, there are many intermediate possibilities. For simplicity consider the same mechanism—as exemplified by the functional requirements of Fig. 3—and, while retaining sufficient of the form to satisfy a conservative customer, yet include as many as possible of the advantages of the thin-walled variant.

One such solution, which need not be looked upon as a compromise but as an effective design in its own right for many applications where a completely shrouded component would be unsuitable, is illustrated in Fig. 6. The separate arms of the bell-crank lever are here retained and, in fact, are slightly broadened, but their section is reduced by drastic lightening. This is achieved by fixed cores mounted in the member opposite to that containing the cavity, so that the two arms are hollowed out from opposite sides as shown. The arms thus formed are connected by a thin flat web, which serves to stiffen the assembly and also gives a simpler profile for trimming.

This could be circular, as in the earlier example, but in the absence of a peripheral wall this offers no advantage, and the edge of the web should, in such applications as this, be tangential to the extremities of the functional parts. Here, this gives a trimming profile that is triangular with rounded corners, quite easy to trim. Without the web, a channel-section arm might fail in torsion under undue stress, but with the section seen, for

example, in the view B-B of the figure, the rigidity is superior to that of a solid rectangular lever-arm.

The simplification of casting profiles—termed "shrouding"—is most generally applied to die-cast gears, where the difference in cost and ease of operation between a plain circular die and one conforming in detail to every tooth profile is considerable. Here, too, of course, there is a considerable accession of strength, particularly in the case of internal gears where the tooth springs from a relatively thin peripheral wall. Shrouding is also desirable on components that are fluted or ribbed, as well as on cylindrical castings having a "milled" surface. In all such cases the die cavity is cut at the parting plane in such a way as to eliminate the re-entrant portions of the profile; examples are seen in Fig. 7.

Although shrouding in such components as that of Fig. 7 (*a*) simplifies trimming, it may nevertheless be inadvisable to adopt it in some applications owing to the difficulties that arise in polishing components with abruptly-finishing grooves. As will be apparent, polishing compounds easily lodge in the pockets so formed, and are difficult and expensive to dislodge. By adopting a gradual diminution in groove depth (as at *b* and *c*), troubles from this source may be avoided.

These same considerations apply, though for different reasons, to castings that are brought to a high lustre by barrelling. Although by a correct choice of chip form and size it is possible to ensure that the bottoms of grooves are adequately polished, the cycle time necessary to achieve this increases as the depth of the groove increases relative to its breadth. Moreover, the edges of the ribs are likely to be worked over too much, so that the edges are rounded off, Fig. 8 (*a*), or —in a badly loaded barrel—are hammered over as in Fig. 8 (*b*). It is only fair to say, however, that barrel-finishing techniques are at present undergoing rapid improvement; by clamping the parts on fixtures so that they preserve a fixed orientation with respect to the flow of abrasive within the barrel, for example, it is possible to even out the polishing action on ribbed or fluted surfaces of large components.

Many small to medium die-castings are subjected to a barrelling operation less to improve the surface finish than to remove burrs and light flash. It is possible to remove heavy flash—0·008 to 0·012 in. in thickness—by appropriate barrelling techniques, but it is seldom that this course is justified. If, for any reason, it is necessary to produce a component consistently with a heavy flash, a procedure for which there is often some practical justification, it is almost always desirable to trim it in a die prior to barrelling. The latter operation then removes the trimming burr and, of course, any light

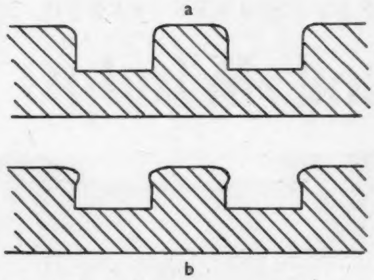


Fig. 8—Ribs, if too closely spaced, may be worn or hammered by prolonged barrelling

flash formed other than in the parting-plane.

The most frequent location for secondary flash—flash that is not trimmable from the component at the same operation that removes the fin at the parting-line—is around ejector stubs (Fig. 9). The incidence of flash at such points is likely to increase as the die becomes worn, and as far as possible ejectors should be located at points where a moderate flash-collar will not affect the utility of the casting. This may entail the placing of ejector pads exclusively within the recesses of the casting; on the other hand, if a flange is to be faced off, or a circumference trued in a lathe, the ejectors should be located so that any flash that may be formed is removed in the course of the machining operation.

In the case of large, flanged components, which may undergo slight distortion in cooling, it is common to pass the flange across a wet-belt grinder to eliminate dishing, and ejectors may then be located directly upon the flange. It is highly desirable that the designer should allow for the ejectors entering some little way into the casting—as much as 0·015 in. if possible—as at *a* in Fig. 9, so that even after belt grinding there may be shallow circular recesses at the ejector locations.

These are seldom objectionable, whereas if a perfectly flat and unbroken finish on the flange face is insisted upon, the die-caster must necessarily achieve this by shortening the ejectors, Fig. 9 (*c*), so that at all times they leave stubs a few thousandths of an inch proud. They are readily ground away, but unfortunately it is almost certain that from time to time during the run ejectors will leave stubs higher than this, projecting perhaps 0·008 or 0·010 in. from the surface. Where this occurs, it becomes more difficult to prevent the casting from tilting when being ground "free-hand" on a belt, and the planarity of the flange, or at the least its relation to axes nominally at right-angles to it is likely to be adversely affected.

It should be noted, however, that the die-caster may himself have objections to ejectors projecting into the casting in the manner of Fig. 9 (*a*), since this prevents the component from dropping clear at the end of the stroke

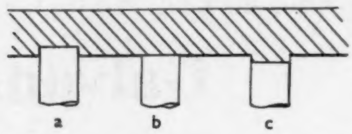


Fig. 9—Ideally, ejectors should be flush with the surface as at b, but inevitable fluctuations result in their occasional projection into the casting a or recession into the die as at c

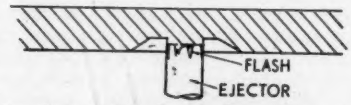


Fig. 10—An ejector seating recessed into the face of the casting has many advantages

and it must be lifted from the ejectors by the operator. The ideal way of providing ejector locations on a flange, therefore, is as shown in Fig. 10. Here, the ejector is brought to bear upon the bottom of a shallow recess of somewhat larger diameter, and it will be observed that the ejector is set a little way back in the die so as to leave a stub standing proud from the bottom of the recess. If the latter is, say, 0·020 in. deep, the position of the ejector can vary within normally encountered limits without standing proud of the flange itself. It must be realized, however, that where this construction is adopted there may well be traces of flash around the ejector location, since these are only bent or flattened when the flange is ground. The die-caster cannot reasonably be expected to remove these frays, which do not interfere with the functioning of the casting, and if, on grounds of appearance, they are undesirable, the method of Fig. 9 (*c*) should be retained even though at the cost of taking a heavier cut when grinding the flange.

Other aspects of this problem of designing in order to eliminate flash occurring at positions where it becomes difficult to remove will be discussed in a later article.

Forging Titanium Alloys

As a result of a recent study of the influence of forging temperature on mechanical properties of aluminium-vanadium-titanium alloys, a high-temperature production forging technique involving press forging from above the beta transus temperature and water quenching from the press has been developed, according to a report made available by the Lending Library Unit of D.S.I.R. Toughness, as measured by V notch Charpy impact resistance at −40°F., may be increased by as much as 50 per cent without any significant effect on strength. By applying these techniques, advantages of improved forgeability, optimum combination of the more important mechanical properties, and reduced costs may be realized.

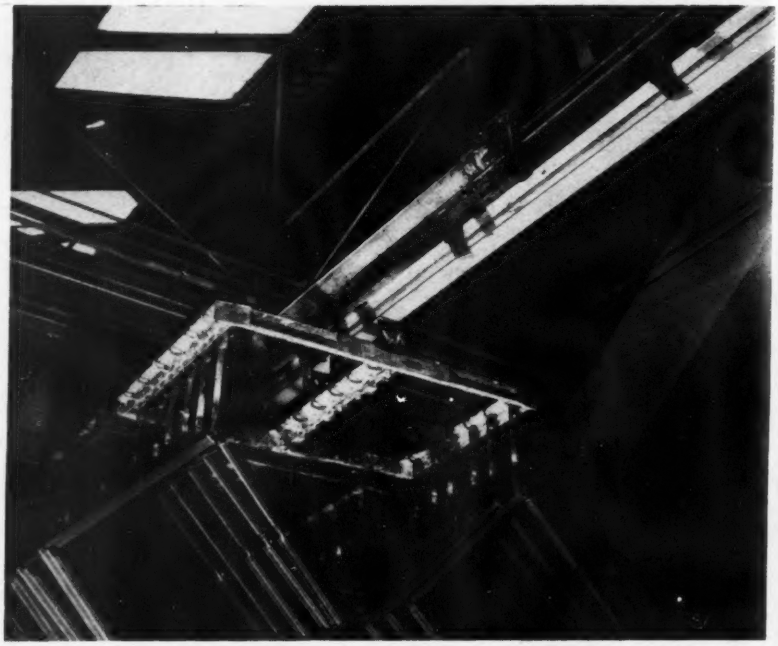
PNEUMATIC EQUIPMENT ASSISTS BATCH PRODUCTION PROCESS

Galvanized Window Frames

NEW building and construction developments, such as the gaining popularity of curtain walling employing zinc- and aluminium-coated steel sheets for exterior cladding of many types of buildings, are providing the metal window industry with a substantial new outlet for its products.

Integration of the new product into current production processes presents few problems, especially where galvanizing is concerned. Three methods are currently employed, namely, hot dip, zinc spray, and electro-galvanizing. The hot dip process accounts for the treatment of a major portion of the output and, although designed to handle large tonnages per shift, is sufficiently flexible to accommodate a variety of products other than metal windows without alterations to plant.

At Crittall Manufacturing Company's Braintree Works, the hot dip process is served by a monorail system, which is part of a works system. Small trolleys or carriers, from which hooks are suspended, are hand hauled short distances along this system, loading being effected by means of lowering short sections of the rail, complete with carrier and suspended hooks. Consolidated Pneumatic 6 in. dia. rams are used in the main shop for raising and lowering these sections, whilst a number of 4 in. units are installed in the paint department.



A Consolidated Pneumatic ram operating the carrier gear for removing window frames from the drier

The hot dip process consists of pickling, two washing stages, fluxing, drying, galvanizing, cooling, and etching stages. The first stage, pickling, is carried out in a dilute solution of hot sulphuric acid, the temperature being controlled to between 140° and 150°F. After mill scale and other impurities have been removed, washing follows to eliminate iron salts, the first wash in a hot tank being followed by a cold wash. To ensure complete washing, the tanks are provided with a constant intake of fresh water and a waste overflow.

When all iron salts have been completely removed, a flux of zinc ammonium chloride is applied at a temperature of 150°F. This is effected in a further bath, and its object when dry is to ensure an even flow of zinc in the galvanizing stage, and to facilitate its alloying with the steel.

After fluxing, the next stage consists of drying in a carefully-controlled air temperature. The removal of moisture is essential to prevent spattering in the galvanizing stage, and close temperature control is necessary to prevent breakdown of the flux by interaction with the steel, with consequent heavy dross formation in the zinc bath.

From pickling to drying, the stages are carried out by a fully automatic circuit. After drying, however, the trolleys carrying the products to be galvanized are hand hauled a short distance to the galvanizing bath, an arrangement which allows ample flexibility in the system.

A separate circuit controls the next group of stages. These commence with the galvanizing stage, carried out in a molten zinc bath kept at a temperature of 860°F. The surface is skimmed before immersion to remove zinc oxide and to prevent any possible contamination of the products, it is skimmed again before the windows or plates are withdrawn. A cooling stage follows, and where frames or sheets are required to be painted they are treated by etching in a weak solution of phosphoric acid and zinc phosphate. This provides a roughened surface and a phosphate coating, which has been found highly suitable for paint work.

Of prime importance in the process is a precise degree of control, whilst a measure of flexibility is necessary to deal with products other than standard.

The first of the two circuits is fully automatic, a timer being actuated by the fall of hoists controlling the vertical movement of the frames. When the timer makes contact, solenoid-operated air valves supply air to the 4 in. dia. rams responsible for horizontal movement, the whole operation being contained by a series of integrated circuits incorporating "latch in" and "latch out" stages.

The Consolidated Pneumatic rams used for the carrier gear throughout the process operate in a highly corrosive atmosphere, being subject to acidic fumes from the tanks and to accumulations of corrosive material which tends to form on top of the cylinders. They are regularly inspected and maintained, however, and have been found thoroughly suitable to meet the conditions.

Electronic Analysis

AT the recent Gas Liquid Chromatography Symposium, Amsterdam, a new instrument, the Pye argon chromatograph, with an extremely high column efficiency and fast analysis, was demonstrated by W. G. Pye and Co. Ltd., Cambridge.

It is capable of being operated by non-specialist personnel, and the effects of pressure, flow and temperature are so insignificant that the degree of control is set solely by the column requirements.

The insertion of minute samples in the order of 0·1 microlitre to 0·025 microlitre by use of a micropipette is extremely simple. Sensitivity range is approximately one part component in 2×10^6 to 2×10^3 carrier gas (Argon) for full-scale deflection on the recorder. The limit of detection is one part of component in 2×10^8 of carrier gas.

FINAL SESSIONS OF FIFTH INTERNATIONAL CONFERENCE

Hot Dip Galvanizing

(Continued from METAL INDUSTRY, *11 July 1958)*

CONTINUING the report of the proceedings at the Fifth International Conference on Hot Dip Galvanizing, held at Knokke-le-Zoute, Belgium, and organized by the Zinc Development Association in collaboration with the corresponding associations from Belgium and the Netherlands, we publish here an account of the main features of the last two sessions, numbers 8 and 9. The subject under review at the eighth session was "Human Progress Through Technical Progress"—this also being the theme of the Brussels Universal and International Exhibition—and the subject for the final session was "Materials Handling."

Contribution of Galvanizing to Human Progress

By R. LEWIS STUBBS

THE difficult art of zinc smelting was not introduced into Europe until the middle of the eighteenth century. At about the same time the French chemist Melouin suggested applying a zinc coating to iron objects by dipping them in the molten metal, but it was not until Sorel introduced a practical method of cleaning, a hundred years later, that galvanizing became a commercial process.

The progress that followed from the Industrial Revolution gave impetus to the new industry and galvanizing was much in evidence at the first Universal Exhibition in 1851. Corrugated iron, a new product, found a big market in the new countries where the settlers soon appreciated its convenience, and galvanized wire was becoming widely used for fencing. A British firm installed special plant to galvanize the wire for the first Atlantic telegraph cable. In the 1870s the inventions of Bessemer and Siemens made steel widely available and increased the field for galvanizing, while the new interest in hygiene created a demand for galvanized tube.

Since 1900 the expansion of the industry has been even more rapid, and galvanizing is now used for a wide variety of steel structures, including mine cars, bridges, television towers, ships' deck fittings and livestock feeding troughs. The future expansion of the industry depends upon an even wider acceptance of the economic value of long-term protection, on greater productivity and lower costs and on the provision of coatings with even better corrosion resistance.

DISCUSSION

In a subsidiary Paper which was presented on behalf of **Mr. J. Derrider** attention was drawn to the fact that all the Papers presented at the various conferences and all the bibliographies used by the various authors of Papers bear witness to the extent and importance of the researches which lay at the base of technical progress in the galvanizing industry.

It might appear paradoxical that, while possessed of so much scientific and technical knowledge, the development of the galvanizing industry should appear relatively slow. In fact most of the means required to improve the quality of galvanized products and production techniques were at hand, but for a long time there were not sufficiently large markets to allow more speedy development.

But progress is not indefinitely to be denied and for the last 20 years, and particularly during the last decade, the field for the practical application of galvanized articles has been considerably widened; and in view of the increased demand, the industry has been considerably developed with the aid of all the knowledge supplied by scientific chemistry, physical chemistry, metallurgy, electricity and electronics. The improvements in technical production have brought with them gains both in quality and in costs of manufacture.

Galvanizing is now considered as the most effective method in the battle against corrosion.

Giving details of hot dip galvanizing in the Netherlands, **Mr. J. F. H. van Eijnsbergen** (Stichting Doelmatig Verzinken) said that the rapid industrialization in Holland after the Second World War called for an additional and indeed substantial tonnage of zinc for the galvanizing process.

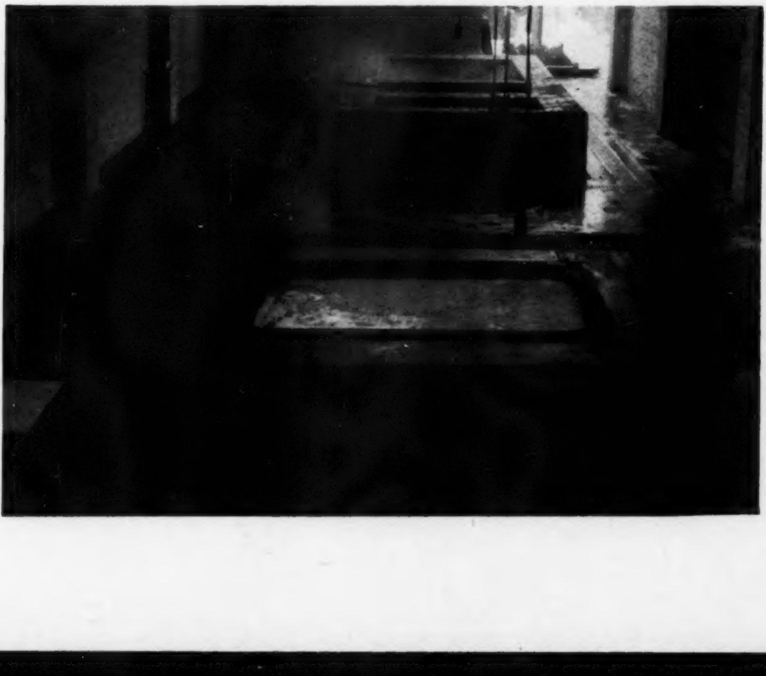
Hot dip galvanizing made it possible to keep maintenance costs low on many costly structures and works, and every effort is made to bring this knowledge, already possessed by the larger industries, down to the general public, which is still rather poorly informed on corrosion protection problems.

A new application of hot dip galvanizing is the protection of steel structures in calcium-, ammonium- and sodium-nitrate plants, in order to avoid stress-corrosion cracking. Here hot dip galvanizing proved to be the only effective way of preventing nitrates producing this special form of corrosion of the steel.

A significant feature during the last ten years is the constantly increasing pollution of the atmosphere by industrial gases, which cause an accelerated corrosion of zinc coatings. An extremely efficient solution is the painting of the zinc surface under such conditions with chemical-resistant coatings, and it has been found that not only the zinc coating will last considerably longer, but also the paint system on the zinc surface will show in itself a higher durability of 40 to 65 per cent.

It is important, however, to use

Galvanizing bath, of pre-fabricated demountable re-usable sections built by Stordy Engineering Ltd., for Galvanizers Ltd. The bath is 6 ft × 4 ft × 5 ft deep, employs gas-fired multi-burner setting, and is designed for a throughput of 15 cwt/hr



coating systems which adhere permanently and perfectly to the zinc surfaces in order to obtain the maximum of corrosion resistance.

He then gave an illustrated survey of some of the many new applications of hot dip galvanizing in the Netherlands, the slides covering some applications of hot dip galvanizing in the following branches of industry: electrotechnics, railway equipment, house building, agriculture, shipping, mining and chemical industries.

Regretting that the Papers and discussions had dealt more with technical than human progress, **Mr. A. Boddaert** (Arbeit-Division—Clouterie et Tréfilerie des Flandres) felt that something was missing. He realized, however, that the speakers had had a difficult task in view of the fact that no clear definition of human progress existed.

Following this session three films were presented: "No Rust Here" and "Work Study," both sponsored by the Hot Dip Galvanizers Association, and another dealing with improvements in handling and working conditions in a galvanizing shop.

Referring to the film on work study, **Mr. F. C. Braby,** said that part of it had been taken in his works, and while the film showed the application of work study to the galvanizing of 40 gall. cisterns they were not always dealing with that class of work. In point of fact it was impossible for every item to be work-studied and what was needed in most works was an engineer who would study the processes—not necessarily in detail—and then suggest means of overcoming their difficulties. There was a danger that the film would convey the idea that a work study man was essential. In his opinion much could be done by (1) improvement of layout; (2) co-operation from the customer so that similar articles could be galvanized at the same time; (3) proper sorting and (4) better ways of handling. The great problem that remained, however, and one difficult of solution, was that of effective supervision.

With materials handling as the subject for discussion the main Paper in the ninth session, which is abstracted below, was presented by **Mr. A. G. Northcott** (Zinc Development Association).

Materials Handling in Galvanizing

By A. G. NORTHCOTT

MATERIALS handling is vital to human progress but, although important advances have been made in the past, its proper development has been retarded by the availability of cheap labour.

Its importance to the galvanizing industry is revealed by costing and, more particularly by detailed studies which show that handling absorbs most of the labour costs. Methods of improving efficiency are set out in detail, and again emphasize the importance of handling to the industry.

A section deals with some of the causes of bad handling and shows how charting methods reveal possible improvements. The practice of dealing with handling problems piecemeal is condemned, and the use of unsuitable handling equipment is shown to lead to inefficiency.

In discussing the influence of plant layout on materials handling, a number of questions are tabulated, consideration of which should lead to improvements. Three flow diagrams show the existing layout of the two galvanizing works of one company and the improvement to be obtained from the closing of one works and the reorganization of the other to give a much greater throughput. The integration of equipment and handling with layout are clearly shown. The main section deals with recommended practice for materials handling and shows how a systematic study of existing activities should be combined with consideration of a number of handling principles which have evolved from many years of practice. These principles can be summarized: eliminate unnecessary handling; introduce programming; integrate handling with processing; achieve maximum progression and continuity; move in racks, containers or pallets; combine operations wherever possible; use gravity where possible; avoid contact with the floor; classify materials and products; and mechanize wherever possible.

Many photographs illustrate bad handling and many suggestions are made for improving handling in the industry.

The Paper concludes by suggesting that productivity can be doubled, and in some cases increased many times, by a greater concentration on materials handling. The attitude of managers and supervisors will determine results.

DISCUSSION

Saying that "making is 90 per cent handling," **Mr. F. M. Carlson** (American Tinning and Galvanizing Co.) thought that owing to the diverse type of work undertaken by the jobbing galvanizer mechanical handling was difficult to apply. It was, however, the one field remaining in which economies could be made and a systematic analysis of the existing problems was essential. There was no finality—every process should be subject to continual rescrutiny. In the U.S.A. there was a higher degree of specialization than in Europe and this, of course, eased their problems somewhat. The future, he thought, lay in the wider adoption of automation.

Men and Metals

Visiting Amsterdam for two weeks this month is **Mr. R. G. Tant,** technical representative of the Speed Nut Division of Simmonds Aerocessories Limited. During his visit, Mr. Tant will call upon customers and agents to bring them up to date with the new applications found for Spire speed nuts.

At the recent meeting of the International Organization for Standardization, held in Harrogate, **Professor E. A. Wegelius** (director of Finland's National Research Institute) was elected President of the organization in succession to **Sir Roger Duncalfe,** whose term of office expires at the end of this year. The Council of the I.S.O. elected **Vice-Admiral George F. Hussey** (managing director of the American Standards Association) as vice-president for a term of three years in succession to **Dr. Carlo Rossi** (Italy).

Following considerable technical developments and reconstruction at the works of Joseph Batson and Company Limited, **Mr. W. E. J. Cross,** general manager of the company, has been elected to a seat on the board and appointed managing director.

It has been announced by the United Kingdom Atomic Energy Authority that **Dr. N. Levin,** Ph.D., B.Sc., A.R.C.S., F.Inst.P., has been appointed deputy director of the Atomic Weapons Research Establishment.

Appointed organization and methods officer in the Metal Industries group of companies, **Mr. J. E. Hinde** was previously with the London County Council, The Plessey Group, and the Bristol Aeroplane Company.

A.S.T.M. Publications

AMONG recent publications emanating from the American Society for Testing Materials are the following Special Technical Publications.

No. 216—"Large Fatigue Testing Machines and Their Results"; pp. 162. Price $4·25.

No. 220—"Radiation Effects on Materials." Vol. II; pp. 140. Price $3·75.

No. 223—"Non-Destructive Tests in the Field of Nuclear Energy"; pp. 420. Price $10·00.

No. 226—"Elevated Temperature Properties of Weld-Deposits and Weldments"; pp. 228. Price $5·50.

No. 227—"Thermal Properties of Thirteen Metals"; pp. 30. Price $1·25.

A new compilation of standards on Metallic Electrical Conductors has also been published, pp. 334. $3·75.

Each of these publications is obtainable from the headquarters of the A.S.T.M., 1916 Race Street, Philadelphia 3, Pa., U.S.A.

Research Progress

Electroless Nickel

BY RECORDER

DEVELOPMENT and commercial applications of the electroless nickel plating process have proceeded vigorously since the first publications on the subject some ten years or so ago. Essentially the method involves the use of a solution containing nickel and hypophosphite ions into which the component to be coated is immersed. A bright, adherent deposit of nickel is obtained by a mechanism on which general agreement has not been reached. One proposal postulates the formation of hydrogen, which then reduces the nickel ions to nickel: another suggests that the nickel ions are activated during hydrogen discharge and then react with the hypophosphite ions. Whatever explanation is found eventually to be correct, the three main observable features of the process are the deposition of nickel metal, a tendency for the *p*H of the bath to drop and the formation of nickel phosphite in the solution.

Effect of Organic Acids

Weak organic acids substantially affect the performance of electroless plating baths, and the use of hydroxyacetic acid to obtain high rates of deposition was recommended by A. Brenner and G. E. Riddell in early Papers[1,2] on the subject. The results of these workers could not readily be utilized, however, as the improvements in deposition rate were dependent on the purity of the acid and were not attractive when commercially-available grades were used. Consequently, in practice, other additions, notably citric acid, have found wider application although the deposition rates are substantially lower than those obtained by Brenner and Riddell.

The influence of various organic acids on plating rate has been studied by C. H. de Minjer and Brenner[3] at the National Bureau of Standards, Washington. They first report the effects on deposition rate of varying the *p*H of baths containing 30 gm/L. $NiCl_2 \cdot 6H_2O$, 10 gm/L. $NaH_2PO_2 \cdot H_2O$ and 39 or 25 gm/L. hydroxyacetic acid or 15 gm/L. sodium citrate with and without the addition of 5 gm/L. sodium acetate. The rate of deposition was measured on small specimens immersed for short times in a relatively large bath to minimize changes of *p*H during the experiment. Despite this precaution, appreciable decreases in *p*H occurred in the bath containing sodium citrate without the acetate addition and that containing the lower amount of hydroxyacetic acid. In all cases, however, a reduction of the plating rate was found when the *p*H was lowered, and for the more concentrated hydroxyacetic acid bath the rate decreased from about 30 microns/hr. to about 13 microns/hr. as the *p*H was changed from a little over 5·0 to about 4·1.

In their description of the above work, de Minjer and Brenner omit to state how the *p*H of the bath was varied—whether by the controlled addition of strong acid or alkali or by operating the bath until the desired *p*H had been attained. This lack of detail becomes more serious in succeeding sections of the Paper, and detracts considerably from the value of the publication. For instance, the investigation of the influence of the organic acid used on deposition rate is discussed without reference to the concentrations of nickel chloride and sodium hypophosphite present in the various baths. From indirect evidence it appears likely that in most cases these were 30 and 10 gm/L. respectively, though experiments using succinic acid may have been conducted with 22 gm/L. nickel chloride and 30 gm/L. sodium hypophosphite (presumably to correspond with the bath composition revealed in a patent describing the use of succinic acid). It is further stated that the baths were "operated at an initial *p*H of 4·2 to 4·3," but it is impossible to ascertain how this *p*H was obtained.

Effects of Concentration

The effects of varying the concentration present in the bath of seven organic compounds are shown graphically. All the curves exhibit similar features, namely a rapid initial rise in deposition rate as the amount of compound is increased, followed by a fall in the rate at still higher concentrations. The fastest deposition (nearly 28 microns/hr.) was obtained with lactic acid at a concentration of about 25 gm/L. This was followed by hydroxyacetic acid, and the lowest rates were obtained with tartaric acid additions. Glycine gave a relatively low rate of deposition (maximum about 10 microns/hr.) but changes in concentration did not substantially alter the plating rate in the range 10-50 gm/L.

Bath Stability

The stabilities of the baths were assessed by comparing the quantities of nickel deposited on the bottom of the beaker holding the solution and the amounts of nickel compounds precipitated. Both lactic acid and acetic acid baths were found to be unstable, and the rate of plating in the hydroxyacetic acid solutions decreased considerably after only short operating times. Unfortunately, experiments on citric acid baths do not appear to have been so nearly as extensive as for the other compounds, and the effects of concentration on the deposition rate and stability do not seem to have been determined.

No general explanation of the form of the deposition rate/acid concentration curves appears acceptable to de Minjer and Brenner, though acid adsorption on the active nickel surface might give rise to curves of this kind if it could be assumed that in each case investigated the higher concentrations of acid led to a "poisoning" of the surface by over-adsorption. It is suggested that complex formation is not an essential feature of the effects of acids, since succinic acid is thought not to give a nickel complex and yet exhibits a rate/concentration curve very similar in form to those given by hydroxyacetic and lactic acids, which do form nickel complexes.

Process Mechanism

The effects of various substances known to affect hydrogen overvoltage were studied in an attempt to elucidate the exact mechanism of the process. The bath containing 30 gm/L. nickel chloride, 10 gm/L. sodium hypophosphite and 25 gm/L. hydroxyacetic acid was used, and although the results throw little light on the fundamentals of the process, they show that considerable improvements in electroless plating rates can be achieved. The most outstanding results were obtained with small additions of thiourea. About 0·5 mg/L. of this compound raised the deposition rate from about 20 microns/hr. to about 40 microns/hr. Further amounts caused a lowering of this rate, however, and at a thiourea concentration of 1·5 mg/L., deposition was practically stifled. Selenic acid also improved the plating rate (to a maximum of nearly 30 microns/hr.) but the concentration of this compound was less critical than that of thiourea, and rates equal to or greater than the original value were obtained with the acid present in any amount up to 7 mg/L. The plating rate was decreased steadily by increasing concentrations of pyridine, peptone or cadmium chloride, whereas potassium thiocyanate gave similar results to thiourea, the maximum deposition rate being, however, somewhat lower (30 microns/hr. at 0·5 mg/L. thiocyanate).

As well as improving the rate of deposition, small additions of thiourea

gave a brighter coating and increased the stability of the bath. These advantages tended to diminish, however, after the bath had been in use for some time, and it was suspected that the thiourea was being used up in some way. By making controlled additions of thiourea to a bath in which plating was proceeding, the deposition rate could be maintained at about 40 microns/hr., although the brightness of the coating decreased slightly after some time. It is to be regretted that the reasons why these small additions so profoundly affect the process could not be elucidated, since commercial practice cannot directly benefit from results obtained on hydroxyacetic acid baths: however, the potential improvements have been fully demonstrated.

References

[1] A. Brenner and G. E. Riddell; *Proc. Amer. Electroplaters' Soc.*, 1946, **33**, 16.
[2] *ibid*, 1947, **34**, 156.
[3] C. H. de Minjer and A. Brenner; *Plating*, 1957, **44** (12), 1297.

Generating Nitrogen

FOR the production of nitrogen as a neutral gas, or for other industrial purposes, a newly designed nitrogen generator has been introduced by Birlec Limited. The equipment comprises a flue gas generator (exothermic type) integrally coupled with a carbon dioxide stripper.

The flue gas is generated by the combustion of a suitable fuel gas (e.g. purified coal gas, propane, butane, blast furnace gas, etc.). The ratio of gas to air is controlled to provide a minimum oxygen content in the combustion products.

The ratio of fuel gas to air is preset to provide a given product gas composition. This preset ratio is obtained first by controlling the pressure of the fuel gas relative to the atmospheric pressure; then orifices are set for the gas and the air in order to provide the required fuel/air ratio. Normally the residual combustibles in the combustion products are required to be at a minimum, but for certain purposes it may be necessary to maintain a small and positive residue of combustibles to provide slight reducing conditions.

Compressed pre-mixed fuel gas and air are burned in an immersion heater. This enables the majority of the heat of combustion to be used in the regeneration of the fluid which absorbs the carbon dioxide.

The combustion products, after being largely cooled in the immersion heater, pass to a heat exchanger, where the gas stream is further cooled to the neighbourhood of ambient temperature, thus removing water vapour by condensation and making the gas cold enough to obtain a high degree of absorption.

Cool gas then passes upwards through the absorption tower and carbon dioxide is stripped by the downward flow of absorbent fluid.

Nitrogen passes from the top of the tower and, after cooling, may be used as such, or, if required, may be suitably dehumidified in a standard Birlec adsorption dryer.

The absorbent fluid which has taken up the carbon dioxide is pumped through a heat exchanger for preheating and is then delivered to the top of the reactivation tower. The fluid flows down the tower and gives up carbon dioxide. As already stated, the heat for driving off the carbon dioxide is provided by the combustion of the fuel gas.

The reactivated fluid flows from the reboiler through a heat exchanger for part cooling, where it gives up heat to fluid about to enter the reactivation tower. In a further heat exchanger the fluid is cooled and is then pumped into the absorber tower fresh for use.

Consumption of utilities per 1,000 ft^3 nitrogen is as follows: town's gas (depending upon composition) 300 ft^3; propane 50 ft^3; butane 40 ft^3; water 400 gal.; electricity 2 h.p. (pumping), 1-1½ h.p. (blowing). The nitrogen produced contains only trace amounts of oxygen and carbon monoxide, and the hydrogen and carbon dioxide content are not greater than 0·5 per cent.

Neutral gas generator, comprising a flue gas generator integrally coupled with a carbon dioxide stripper, recently introduced by Birlec Ltd.

Metal Statistics

AN enlarged edition of the Year Book of the American Bureau of Metal Statistics (50 Broadway, New York 4, N.Y.) records for 1957 and prior years, mine production, smelter production, consumption, imports and exports, and other economic statistics, on a world-wide basis. Commercial information for copper, lead, zinc, nickel, aluminium, bauxite, gold, silver, tin, antimony, cadmium, cobalt, magnesium, molybdenum, and platinum and sundry ores and metals is reported on. There are also introductory texts on the major non-ferrous metals, reviewing the events of 1957; tables of metal prices, monthly and annual; lists of metallurgical plants and their capacities; general economic statistics of the United States, and U.S. duties on principal ore and metal imports; plus other extensive data.

The Year Book provides voluminous statistical information for market analysis, research and industry surveys.

The price is $4·50 a copy (hard cloth covered) and $4·00 (soft paper covered) plus 25 cents outside the U.S. and Canada for postage and handling.

New Plant & Equipment

Briquetting

A RECENT addition to the range of presses manufactured by Entwistle and Gass Limited, and marketed by their associates, the Planters Engineering Company Ltd., 14 Craven Road, London, W.2, is the "Autobraav" press, for forming copper and brass millings into briquettes or pellets of convenient size for handling, storage, and subsequent remelting.

The cycle of operation is started by the delivery of the millings into a storage hopper, which forms part of the standard equipment, from which they are fed by vibratory feeders into the first stage low compression cylinder. This cylinder incorporates a variable setting electro-measuring device, which automatically predetermines the weight and size of the finished briquette. In this first-stage cylinder, the millings are subjected to a preliminary pressing, then automatically transferred to the high-compression chamber for final processing, finished briquettes or pellets being automatically ejected from the machine in a complete state of readiness for storage or remelting.

Completely automatic in operation, the press is remotely controlled by a single operator at a conveniently-situated console type control panel. Among the safety devices fitted is a cut-out to prevent the machine operating should the supply of millings cease.

The output approximates to 6½-7½ cwt/hr., comprising some 210 briquettes of between 3 and 4 lb. each.

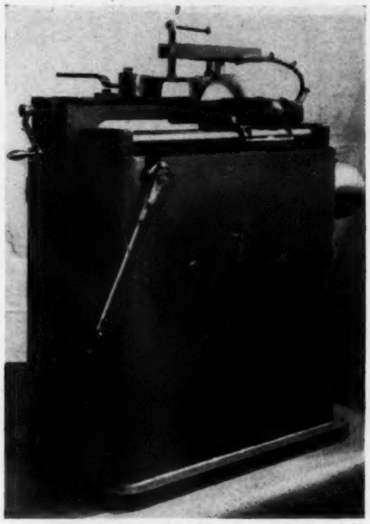
Sawing

A DEPARTURE from the standard type machine, the Eisele MS III/G traversing metal circular sawing machine employs two guides on which the saw head travels, thus enabling the capacity to be increased to a range of approximately 9½ in. by 2½ in.

With the use of different saw blades, any material from thin to heavy sections may be cut. Work can be cut at a speed far superior to hacksaw or bandsaw. Solid M.S. bar material up to 2 in. diameter is also well within its range. The machine is also available with a higher speed for the cutting of all non-ferrous metals up to 3 in. high.

Cutting time for copper 6 in. by ⅜ in. flat is 14 sec.

The machine is a product of The Addison Tool Company Ltd., Addison House, 28 Marshalsea Road, London, S.E.1.



The Eisele MS III/G traversing metal sawing machine

Oven Heating

BECAUSE of its performance and construction, an oven introduced by Hedin Limited, Commerce Estate, South Woodford, London, E.18, has many uses not only in industry, but also in laboratories.

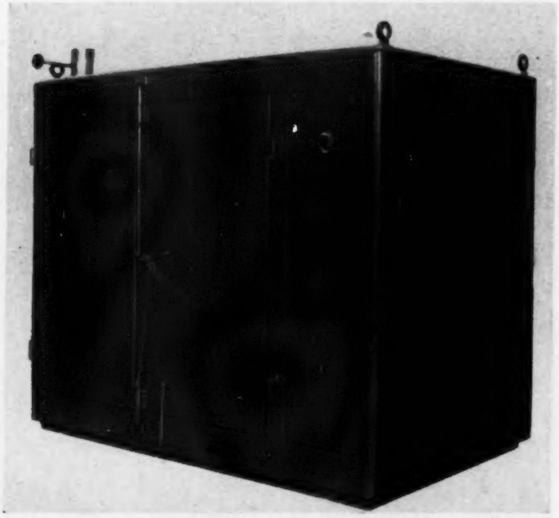
Normal temperature control is ±1 per cent of the operating temperature, up to either 200°C. or 425°C., as required, but straight line control is also available. Forced air circulation is by means of a centrifugal fan, and is continuous throughout the oven and heating chambers. There are about 20 air changes per min.

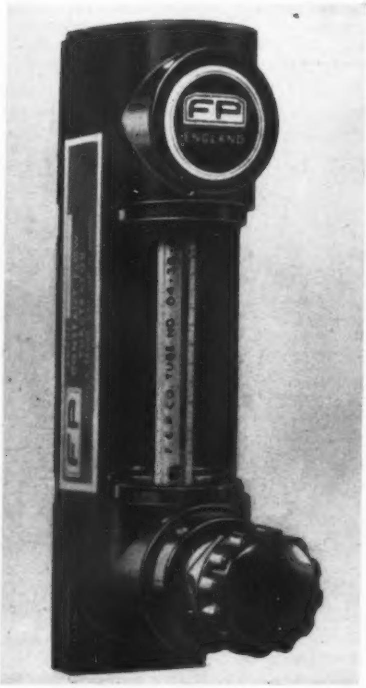
Each unit is supplied complete with readily accessible gear giving instant visual indication of operation, plus suitable electrical protection. The fan and motor, for instance, are interlocked with the heaters so that the latter cannot be switched on without the fans. The fans may, however, be run independently.

A butterfly valve to give controlled

Left: The Autobraav briquetting press

Below: The Hedin forced air circulation oven





The Purgerator indicating variable area flowmeter

air circulation/recirculation is available, together with various other items such as a vertically lifting door and shelves or trays.

A wide variety of sizes is available, both with vertical as well as the horizontal airflow described.

Flow Measurement

AN indicating variable area flowmeter produced primarily for controlling the flow of gases and liquids at a constant rate for bubbler service applications and purging operations, as with corrosive service manometers, has been put on the British market by Fischer and Porter Ltd., Salterbeck Trading Estate, Workington, Cumberland. Additionally, this instrument, the Purgerator (Models 1115 and 1120), is used in conjunction with the F. and P. constant differential pressure regulator for measuring liquid level in an open tank. For other diverse applications where a small flow-indicator is required, the Purgerator is ideal.

The meter is available with or without an integral 18:8:3 stainless steel needle valve. The ¼ in. B.S.P.T. or N.P.T. threaded connection inserts may be either in brass or stainless steel. The metering tube is of borosilicate glass, and may be scaled in any desired units of flow for 10 to 1 ranges, from 0·08-0·8 c.c/min. air to 142-1,420 c.c./min. water and 3,820-38,200 c.c./min. air.

Routing Non-Ferrous Metals

ROUTING, a name given to high-speed milling, is the particular process used in the production of parts made by Routing Limited at their new factory at Faggs Road, Feltham. This process employs a template or guide arrangement that is fitted over the workpiece in such a manner that a loose collar or roller mounted on the driving spindle can be maintained in contact with the edge of the template by pressure applied to the head by the operator.

Spindle speeds vary from 3,000-24,000 r.p.m., according to the material being cut and the diameter and setting of the cutting tool.

In 1939, experiments were made to develop the process for machining light alloys, particularly in connection with aircraft components. The speed with which non-ferrous metals could be removed by the routing cutter excited the interest of production engineers. The process was, however, deficient both in regard to accuracy and depth of cut obtainable. For some time, therefore, it had a limited use as a roughing-out tool for light alloy sheet material.

As subcontractors to many leading aircraft firms, Morfax Ltd., the parent company from which Routing Ltd. has developed, received requests for the economic production of experimental machined components from the solid in the new alloys, and they set about increasing the depth of cut that could be made in one pass of the cutter, producing a cutter which successfully cut a depth of 3 in. in light alloy material. In the course of these early experiments, close liaison was established with the manufacturers of the routing machines, Wadkin Ltd., of Leicester, and this co-operation eventually led to the development of equipment capable of cutting to a depth of 6 in. or more.

Morfax next turned their efforts towards improving the accuracy of routing; this they achieved by a combination of cutter guide and template modification, together with further studies of cutter tool design. Success in this field eventually led to the production of form tools, and the variety and scope of the improved process enabled the routing department to undertake production runs in addition to the prototype work. With the increased loads involved on the routing machines, Wadkin Ltd. produced new equipment of more robust and versatile design, which enhanced the accuracy and efficiency.

Another application of the process has been the development of skin-milling for aircraft and similar highly-stressed sheet components. In this operation, the thickness of the sheet or skin is reduced over all areas except where stiffeners, ribs or attachment points are located.

The result is a skin possessing integral stiffeners and reinforcement machined from the solid, and having all changes of section evenly radiused.

The new factory is at present equipped with some twenty Wadkin routing machines of various types, including three fitted with 20 h.p. heads and one with hydraulic depth control, with nine more machines due for delivery within the next two months. In addition, there are special-purpose routing machines, including a twin-operator skin-milling machine capable of handling plates 6 ft. in width to an unlimited length.

Supporting this installation are machines to handle tooling and templates manufactured for the routing production line, including Victoria and Wadkin mills, Smart and Brown and Colchester lathes; Jones and Shipman tool and cutter grinders, a Bohner and Koehle boring machine with Hilger and Watts optical setting, and a V.36 Do-all bandsaw and filing machine. Blending and finishing equipment includes rumbling plants of various sizes and a Vacublast installation, the whole organization being adequately covered by a well set up inspection department.

A new factory building of some 18,000 ft^2 is in course of erection at the rear of the existing premises.

The experimental department for Routing Limited has been retained at the Mitcham works of Morfax Ltd., where, at the present time, experimental work is in progress in connection with the routing of titanium and high-tensile steel alloys.

Lithium

ISSUED recently by The Royal Institute of Chemistry, "Lithium and its Compounds," by D. S. Laidler, is No. 6 in the Institute's series of lectures, monographs and reports. Arranged in three parts, the booklet first deals briefly with the principal ores from which lithium and its compounds are obtained, it then discusses the manufacturing processes for extracting lithium carbonate, for processing lithium carbonate to (a) hydroxide, (b) halides, (c) other compounds, for obtaining other compounds from lithium hydroxide, and for the manufacture of lithium metal and the compounds derived from the metal. The third section discusses at some length the properties and uses of lithium metal, alloys and compounds.

This booklet, of 33 pages, is available, price 5s. 0d., from the Secretary of the Institute at 30 Russell Square, London, W.C.1.

Industrial News *Home and Overseas*

Machine Tool Demonstration

An opportunity to see some of the latest imports of Continental machine tools was taken by executives from all over the country at a machine tool demonstration held in Manchester for three days last week and organized by **Newman Industries Ltd.** Although the chief object of the demonstration was to introduce to the British market a new copying lathe by HEID, it also gave some idea of the remarkable expansion of the Newman Machine Tool Division over the last year.

In this short time, the company has been appointed sole selling agents in the U.K. for seven European machine tool manufacturers, including all heavy Hungarian machine tools. To cope with this expansion, additional showroom facilities are being provided.

Scottish News

According to reports from Dundee, **Progrega Limited,** of that city, who completed an arrangement recently with German interests for the exploitation of their finishing process, have now carried out a second deal whereby the process will be used extensively in Italy. It is understood that a group of Italian metalworking firms have taken up this process and will develop it in Italian engineering production.

The German agreement, concluded at Frankfurt, will result in three companies being formed: two in Germany with headquarters at Frankfurt, and one in Zurich. One of the German companies will use the process in Western Germany, the other will develop it throughout the rest of Europe except in Italy. Both these German companies will have the same directorates.

The British company will retain a royalty interest in these companies' use of their process. The Zurich company will be owned jointly and equally by Progrega Limited and the German company, and will be responsible for development of the process throughout the world except in Britain. An approach has been made by American interests for exclusive American rights. British work is meantime confined to Dundee, where components are being processed.

Aluminium in Hungary

Mechanization has recently been introduced into the Inota Aluminium Foundry in Central Hungary, and our photograph on this page shows tapping being carried out at the factory.

Sir John Cass College

For the coming 1958-59 session, a 56-page prospectus has been issued, in which full details of the various departments of the college are given, also the times of the day and evening classes, fees, and other information relating to the activities of the college.

In the Department of Metallurgy, details of the various courses are given, with time tables of the lectures, etc. Particulars relating to the B.Sc. degree and high degrees of the University of London are given, together with details of the requirements for the Licentiateship and Associateship of the Institution of Metallurgists, as well as for the Royal Institute of Chemistry, and the City and Guilds of London Institute. Copies of this prospectus may be obtained from the Principal of the College at Jewry Street, Aldgate, London, E.C.3.

A Removal

We are informed by **Lees Hall and Sons Limited** that their head office has now been removed from Newhaven to Leicester, and that all sales will be handled from that office. Works and usual production will still be in Newhaven.

The full address of the Leicester headquarters is: Box 124, 1 Moorland Avenue, Stoneygate, Leicester, with the telephone number of Leicester 76302.

Copper Tax in U.S.A.

A notice was published in the *Board of Trade Journal* on July 23, 1955, stating that the period of suspension of the United States import excise tax on copper and articles containing copper had been extended from June 30, 1955, to June 30, 1958. No new Bill to continue the suspension of this tax has been announced and accordingly the import excise tax was automatically reimposed on July 1.

Exporters may wish to be reminded of the rates of tax now leviable with effect from July 1. These taxes are, of course, in addition to the normal rates of import duty.

Copper-bearing ores and concentrates, 1·7 cent per lb. on copper content, provided that ores or concentrates usable as a flux or sulphur reagent in copper smelting or converting and having a copper content of not over 15 per cent, when imported for fluxing purposes shall be admitted free of this tax in an aggregate amount of not over 15,000 tons of copper content in any one year.

Articles provided for in paragraph 316, 380, 381, 387, 1620, 1634, 1657, 1658 (except copper ore) or 1659 of the Tariff Act, 1·7 cent per lb. on copper content, provided that no tax under this section shall be imposed on copper in any of the foregoing ores, concentrates, or other articles which is lost in metallurgical processes.

Articles dutiable under the Tariff Act, not provided for heretofore in this section, in which copper (including copper in alloys) is the component material of chief value, 1·275 cent per lb.

Articles dutiable under the Tariff Act, not provided for heretofore in this section, containing 4 per cent or more of copper by weight, 1·25 per cent *ad valorem,* or 0·32 cent per lb., whichever is lower.

Cabma Register

Just published is the 1958-59 edition of Cabma Register of British Industrial Products for Canada. This Register has been published annually since 1953 for the Canadian Association of British Manufacturers, whose object is to develop an ever greater market for British goods in Canada and so stimulate the two-way flow of trade between the two countries.

In this sixth edition of the Register, emphasis has again been placed upon capital and industrial goods of British manufacture required by Canadian industry. All the information contained in previous editions, including up-to-date alterations in the telephone exchanges, has been included to the very latest date. The Buyers' Guide lists alphabetically some 3,200 British products available to the Canadian market, with their suppliers given under each heading. The French equivalents of these headings are set out in alphabetical order in a separate glossary. A directory of nearly 4,000 British firms gives details of their distribution arrangements in Canada. Proprietary names and trade marks are given in special sections which enable the Canadian buyer to identify products and their sources of supply.

The Register is published jointly by

Tapping operations at the Inota Aluminium Foundry, Hungary

Kelly's Directories Limited and Iliffe and Sons Limited at the price of 15s. 0d., and can be obtained from Dorset House, Stamford Street, London, S.E.1.

U.K. Metal Stocks

Stocks of refined tin in London Metal Exchange official warehouses at the end of last week totalled 18,442 tons, comprising London 6,257, Liverpool 10,775, and Hull 1,410 tons. Copper stocks totalled 13,157 tons, and comprised London 7,524, Liverpool 5,358, Birmingham 75, Manchester 50, and Swansea 150 tons.

Aluminium Concrete Mixer

A mobile concrete mixer, made of aluminium alloy to give reduced weight and increased payload, which is the first of this construction to be used in Great Britain, and probably the first anywhere, has recently been overhauled after its initial two years in service, in which time it carried over 14,000 yd^3 of concrete. During this overhaul, undertaken by Fredk. Braby and Co. Ltd., of Bristol, the fabricators of the aluminium work, it was found that the alloy shell was in remarkably good condition, and that the interior had been reduced in thickness due to abrasion by the concrete aggregate by only 0·020-0·030 in. The steel mixing blade, by comparison, had been considerably worn, by approximately $\frac{1}{16}$ in. all over and in places to a knife-edge.

This aluminium alloy mixer, which is no different in basic design from a steel one, was built in September, 1955, and put into regular service by F. Bowles and Sons Ltd., of Cardiff, early the following year. The drum is approximately 7 ft. in diameter and 12 ft. long, and weighs 1,500 lb.; it was made throughout from $\frac{3}{16}$ in. thick Noral B54SM plate, supplied by **Northern Aluminium Company Ltd.**, with stiffening rings in Noral 54SM bar. The plate was argon-arc butt welded both inside and outside, and the heavier rings were Argonaut welded on the outside. The interior spiral blade was made from $\frac{3}{16}$ in. steel plate bolted to Noral aluminium alloy brackets welded to the inside of the drum. Since the introduction of this mixer in 1955, two others of the same capacity have been put into service by F. Bowles.

Submarine Power Cable

On Sunday last (July 13), a second circuit in the 138,000-volt submarine power cable link between Vancouver Island and the mainland of British Columbia was put into commission. The cable was manufactured for the British Columbia Electric Company by **British Insulated Callender's (Submarine Cables) Ltd.,** at their Trafford Park Works, Manchester. British Insulated Callender's Construction Company Ltd. were responsible for the laying and testing of the cable.

Open Days at Oldbury

During the first two days of this week, invitations were issued to those interested in the production of black-heart malleable iron castings to visit the new Halesowen foundry of **Shotton Bros. Limited.** During its 62 years of existence this Oldbury firm has found it necessary to indulge in extensions to its factories three times, and this latest, the third, occasion, has seen the building of a new foundry on a ten-acre site at Lodgefield Road, Halesowen, Worcs.

This latest extension, which has cost about £300,000, was found necessary in order to meet the increased demand for the firm's products. Actual production in the new foundry began some three months ago, since when working capacity has been expanded to about two-thirds of the full potential. The company was originally a family concern, three generations having been associated with it. To-day it is a subsidiary of the Birfield Group of Industries.

Companies engaged in supplying equipment and machinery for the new foundry include the following:—**Modern Furnaces and Stoves Ltd.** (rotary sand dryers), **J. W. Jackman and Co. Ltd.** (bench core blowers), **B. J. Richardson and Sons Ltd.** (Tilghman's shot-blast equipment), **Nu-Way Heating Plants Ltd.** (Rotavac Industrial oil burner), **Luke and Spencer Ltd.** (four 20 in. duplex grinders), **British Moulding Machine Co. Ltd.** (moulding machines), and **The Midland Heating and Ventilation Co. Ltd.** (three Midac wet dust arresters—incorporating "Gyraflo" fans—for shot-blast and grinding sections, and foundry knock-out dust collection.

Electronic Equipment

Brought into being to cater effectively for a rapidly growing market, and with a fully qualified staff, **Research and Control Instruments Ltd.** brings a number of related techniques together. It makes available to the British market an extensive range of electronic equipment gathered from many experienced sources. The many branches and permutations of electronics are thus presented by this new company supplemented by helpful advice and recommendations.

In addition, the company has produced the first edition of a 16-page publication under the title of "R.C.I. Standard," in which various types of equipment are described and illustrated. This publication may be obtained from the offices of the company at Instrument House, 207 King's Cross Road, London, W.C.1. The first issue contains an article on developments in non-destructive testing by X-rays, another on the latest Philips 100 kV electron microscope, and other interesting notes on various instruments.

New Bauxite Find

According to news from Darwin, Australian and overseas mining concerns are investigating reported finds of bauxite in Arnhem land, on the north-east tip of Australia's Northern Territory. The Minister for Territories, Mr. Paul Hasluck, has left by air for Gove Airstrip, a former wartime emergency landing area in the north-eastern corner of Arnhem land, to inspect the area. Reports said that Gove Airstrip had been "built almost on solid bauxite." The Consolidated Zinc Corporation of Australia and the American Reynolds Mining Corporation are reported to be interested and to have sent survey teams into the area. Arnhem land is a declared reserve for Australian aborigines, and any mining venture in the 30,000 square miles territory would meet Government approval.

Aluminium Exports

Japanese aluminium rolling mills have joined the chorus of complaint by Japanese exporters against competition from lower-priced Communist Chinese goods in south-east Asian markets. A spokesman for the aluminium rolling industry said the decline in Japan's exports of rolled aluminium goods from 656·5 tons in April to 593·7 tons in May was at least partly attributed to strong competition from Peking, as well as from West European countries. He said China, presumably using low-priced primary metal from the Soviet Union, had been offering rolled aluminium products, such as circles and sheets, at prices up to 20 per cent lower than similar Japanese goods. He called upon the Japanese Government to persuade aluminium refineries to lower the price of primary aluminium supplied for export production.

Thai Tin Smelter

It is reported from Bangkok that the Thai Cabinet has approved a proposal by the Ministry of Industry to set up a tin smelting plant in Thailand, the Public Relations Department has announced. The Ministry of Industry explained that by constructing such a plant, the country could get the most from its tin ore resources and could save on transportation costs and other charges. At present, Thai tin ore is sent to Malaya for smelting.

The Cabinet suggested that the Ministry of Industry finds ways and means to encourage foreign investment in the setting up of the smelter.

Russian Aluminium

Russia is using aluminium in an "economic attack aimed directly at the United States," according to Mr. R. S. Reynolds, Junr., President of Reynolds Metals Company of the U.S. He proposed "more realistic U.S. Government policies and procedures to deal with this attack." Mr. Reynolds remarked that Russia's aluminium industry was the second largest in the world, was Government-owned and had much lower labour costs, giving it an "unfair advantage" in the world aluminium market.

His views were expressed in a letter accompanying an article on Soviet aluminium production and marketing in the company's house magazine. (Russian competition, in the opinion of many traders, has forced Canadian and United States aluminium producers to lower their prices. On August 1, under current labour contracts, wage increases go into effect throughout the United States industry.)

U.K. Customs Tariff

A new Customs and Excise Tariff of the United Kingdom of Great Britain and Northern Ireland will come into force on January 1, 1959, as provided in the Import Duties Act, 1958. That act consolidates all existing protective duty legislation and provides for goods to be classified for Customs purposes on the basis of the internationally agreed system known as the Brussels Nomenclature. An advance edition of the new Tariff has been published to give traders the opportunity to familiarize themselves with its contents. The advance edition may be purchased through H.M. Stationery Office or any bookseller (price 12s. 6d. net).

This Brussels Nomenclature provides a systematic classification for all goods in international commerce. It is divided into 21 Sections, which are further subdivided into 99 Chapters and 1,095 headings. General Interpretative Rules and Section and Chapter notes ensure that each article is classified in one place, and in one place only. The Nomenclature Chapters are arranged in sequence, beginning with animal and vegetable products, proceeding through raw materials and semi-manufactured goods to manufactured articles classified in

Chapters according to the substance of which they are made, or, in other cases, according to distinctive trade groups.

On the basis of this system, all protective and revenue duties are set out in a comprehensive Schedule in Part 3 of the new Tariff. In this Schedule the Brussels headings are subdivided, where necessary, in order to provide for different rates of duty.

The duty payable is shown against the heading or sub-heading in which goods are classified, except that there are special provisions in respect of spirits, saccharin, matches, playing cards and mechanical lighters in the case of composite goods (i.e., goods containing ingredients which are themselves separately liable to duties). These provisions are set out in Part 3 C of the new Tariff.

The Import Duties Act, 1958, repeals the existing protective duty enactments. An Order made by the Treasury under that Act (The Import Duties (General) Order, 1958 (S.I. 1958 No. 973)) has consolidated the duties chargeable under the repealed enactments into a single Schedule. The effect of this consolidation is to remove the overlapping charging provisions contained in present legislation, which in many cases complicates the determination of duty.

Any duties imposed under the Customs Duties (Dumping and Subsidies) Act, 1957, will appear in a separate Schedule in Part 4 of the Tariff.

The new Tariff includes alongside the Tariff headings a "Statistical Key" giving the statistical code number and description, where different from the tariff heading, and the appropriate unit of quantity. This will greatly simplify the making of Customs entries, as importers and agents will no longer have to refer to an Import List as well as to the Tariff, but will find, in one place in the Tariff itself, what is required of them by way of entry particulars for tariff and statistical purposes. Further, whereas it is at present necessary to include in entries three descriptions of imported goods (technical or trade name, official Import List description and Tariff description) it will be sufficient, when making entry under the new Tariff to give a single description of the goods together with the appropriate Tariff item number and the statistical code number.

In order that importers, forwarding agents, and Customs officials may obtain practical experience of the new Tariff before it comes into force, a scheme, to be known as the "trial run," will operate from September 1, 1958. Under this scheme, the importer or agent, when making entry under the current Tariff, will also complete and attach a special form, C. & E. 936, showing the Tariff item, the description and the statistical code number of the goods under the new Tariff. This form will be checked by the Customs and returned to the importer or agent. Further forms need not be completed for later importations of identical goods.

India's Import Trade Policy

Under Indian Public Notice No. 53—ITC(PN)/58, dated June 9, it has been decided to grant advance licences on an *ad hoc* basis to the scheduled industries for the period October 1958-March 1959 for certain non-ferrous metals, viz. lead unwrought (Serial No. 43-A/1); zinc unwrought (Serial No. 44/1); tin unwrought (Serial No. 45-a/1) and copper unwrought (Serial No. 47/1).

Advance licences granted to scheduled industries under the provisions of this Public Notice will be valid for shipment after September 30, 1958, only, and facility for remittance of the foreign exchange involved will not be allowed before October 1, 1958.

New Representatives

Manufacturers of temperature control equipment, **West Instrument Limited** announce the appointment of Mr. W. Proudfoot, M.A. (Physics) as their area representative in Manchester. Two new overseas agents have also been appointed by the company:—for South Africa, Autronic (Pty.) Ltd., of Johannesburg, and for Hong Kong and the Portuguese colony of Macao, Lepack Co. (1955) Ltd., of Hong Kong.

Chemistry Research

Just published for the Department of Scientific and Industrial Research is the annual report of the Chemical Research Laboratory, Teddington, in which the Chemistry Research Board urges an expansion of the present programme of inorganic chemistry, particularly for research on high-purity materials. The report may be obtained from H.M.S.O., price 5s. 0d. (by post 5s. 6d.).

A Diamond Jubilee

In order to celebrate the diamond jubilee of the **Northern Brassfounders' Employers' Association,** a dinner was held on Friday of last week at the Hotel Majestic, Harrogate, under the chairmanship of the President, Mr. A. Creighton, who was supported by the President and vice-presidents of the National Brassfoundry Association.

Change of Address

We are informed that, as from Monday next, the registered office of **Chemical Construction (Great Britain) Ltd.** will be at Henrietta House, 9 Henrietta Place, London, W.1, with the telephone number Langham 6571.

Oxy-Acetylene Processes

On their stand at the Peterborough Agricultural Show, held during the last three days, **British Oxygen Gases Ltd.** have been including in their demonstrations the hard-facing of ploughshares and the building-up of potato digger chain rods with wear-resisting alloy steel. They have also been showing the welding and cutting of aluminium, and the building-up of die-castings for tractor and other farm vehicle parts.

The company also demonstrated a number of oxy-acetylene processes which had farming applications, such as flame cleaning, gouging and heating, as well as welding and cutting.

Change of Name

Changes in the functions of the Chemical Research Laboratory proposed by the Council for Scientific and Industrial Research have been approved by The Lord President of the Council. In addition, the name of the Laboratory is to be changed to the **National Chemical Laboratory.**

The Laboratory will concentrate its effort on a few objectives, covering only a limited part of the whole field of chemical research, so as to be able to make a real impact on selected problems of national importance such as the following:—

(a) Problems which are appropriate neither to industrial research laboratories nor to universities, because of the necessity for special facilities, experienced staff and continuity of effort. These include the determination of the fundamental physico-chemical properties of chemical compounds which are required, for example, by chemical engineers for the design of full-scale industrial plant. The related study of the development of techniques of purification of materials such as metals and chemicals, with a view to the supply of standard samples of pure substances for reference purposes, is also in this category.

(b) Problems, the solutions of which are of national economic value and have wide general applications to many industries, for example, fundamental and applied studies of the corrosion of metals, which has been estimated to cost the country about £600 million a year.

(c) Problems, the solutions of which are urgently required in connection with the nation's atomic energy programme. These are mainly concerned with the extraction of elements of atomic energy interest from low grade ores.

Residual Fuel Oils

A new treatment for residual fuel oils, low viscosity fuels, distillates and coal tar fuel, has been introduced by the **Amber Chemical Co. Ltd.** The treatment, in the form of a liquid additive known as Amber SSR511, acts to minimize the formation of sludge, by retarding the rate of oxidation occurring in stored fuels, and by dissolving the resins, asphaltenes, gums and congealed residual oil which are the main constituents of sludge.

The formation of sludge is a frequent indirect result of modern refining technique which tends to remove a high proportion of the volatile fractions, leaving the residual fuel correspondingly lower in quality. Some chemical reaction or oxidation of the fuel may occur in storage prior to combustion; a process which is increased by the application of heat and the presence of water. It may be accelerated by minute amounts of metallic compounds, such as copper (probably derived from the fuel system).

The resulting oil insolubles, having a high carbon content, can seriously affect combustion and cause blockages which may lead to repeated overhauls, or a complete stoppage. Amber SSR511, which possesses a greater solvent power than the oil itself, will dissolve the greater part of this sediment before it reaches the burners, and will act to inhibit the oxidation process in the fuel storage tank. The additive is completely soluble in the oil, and its action is not affected by the presence of water. It is non-corrosive and non-volatile. It has a high flash point and is safe to store and handle.

The cost of treatment using Amber SSR511 is approximately 0·06d. per gal. of fuel consumed. The company specializes in the production of fuel and combustion improvers. The treatments now available include Amber Desulfurol SSR509, for residual fuel oils, Amber SSR513, for use with diesel fuels, and Amber SSR113, a combustion additive for use with liquid fuels, and Amber SSR115, for use with solid fuels.

The company is a member of the Amber Group of Companies, which also includes Amber Chemical Industries Ltd., Amber Oils Ltd., Charles H. Windschuegl Ltd., and Causeway Reinforcement Ltd.

Metal Market News

THE week started quietly on the Metal Exchange, the turnovers on the first day being below average, although 1,000 tons of zinc were traded on the midday market. The following day, however, brought a sudden change, for intensive buying of three months' standard copper developed, the turnover for the day being about 6,000 tons, including business done on the Kerb. Values advanced rapidly and in the afternoon the three months' price closed with sellers at £198 5s. 0d. Thereafter, values fluctuated, with cash at one time down to £193 15s. 0d. and forward at £194 15s. 0d., the close on Friday afternoon being £195 for cash and £195 10s. 0d. for three months. The turnover in copper was about 10,000 tons, which is hardly representative of the modest amount of business passing with consumers in this country or on the Continent. There were rumours that the custom smelters' price might fall back from 26 cents to, say, 25½ cents, inasmuch as the value of scrap in the United States has declined. There remains, of course, the question of whether or not Kennecott will advance its price from 25 to 26½ cents so as to be in line with the other producers. On this opinion is divided, but in view of the fact that demand in the States is not very good, there is an inclination to believe that an upturn is unlikely. However, the outlook is nothing if not obscure, and it is impossible to be in any way dogmatic about what is going to happen even during the next few weeks. The import duty on copper is now operative in the United States, but it is early days to say just how this will work out in practice. That Chilean and Canadian surplus supplies will find their way to the Metal Exchange can hardly be doubted, but the course of the quotation is certainly in doubt.

As to the other metals, tin kept very steady and, after a turnover of nearly 900 tons, closed without change in the cash position, while three months put on £2 to close at £731. Of late there does not seem to be so much support by the Tin Council which, of course, means that there is some lessening in the pressure to sell tin on the London market. Consumption of the metal in the U.K. is about normal, but this month and next are likely to see some falling off in activity. Both lead and zinc made a pretty poor showing, and it was reported that lead changed hands during last Friday's trading below £70. At the close, July lead was quoted at £70 and October at £71 15s. 0d., these prices showing a loss of £2 in prompt and £1 12s. 6d. in forward. The turnover was about 4,250 tons. In zinc, a similar trend was discernible, but the fall was not so steep for on balance July lost 15s. at £62 5s. 0d. while October was 12s. 6d. lower at £62 17s. 6d. Some 4,000 tons changed hands during the week.

There is no doubt that since it became known that lead and zinc would not enjoy the support afforded by stockpiling there has been a tendency for them to lose ground, and it seems quite likely that they will fall lower. Nothing definite is known about the subsidizing plan, and in the absence of news there is always the fear that nothing will be arranged before Congress adjourns for the summer recess. Even though it is not doubted that the plan to stockpile 150,000 tons of copper will go through, it is realized that the final enactment of this intention may not go through before the autumn. This and other uncertainties are reflected in the erratic movements of the copper quotation which, it has been noted of late, develops a good deal of hesitancy as soon as it climbs up close to the £200 level. However, the copper ring to-day present a somewhat sold out appearance, and any fairly determined buying never fails to lead to some appreciation in the price.

Birmingham

Production has again been slowed down by a labour dispute in the motor industry, though the stoppage has not affected so many workers as it did a few months ago. In general, trade conditions continue quiet in the metal industries with only a moderate output, and hand-to-mouth buying of raw materials. An encouraging sign is a slight improvement in the building industry, and it is hoped that this will be sustained and helped by the easier financial situation. Short time is being worked in some factories producing machine tools. This is due to a drop in both home and export orders. Business so far this year compares unfavourably with 1957.

Output continues to fall in the iron and steel trades. Even so, consumers can get reasonably early delivery of most products. Now that stocks in consumers' hands have been materially reduced, there are hopes that a spurt in buying may be seen again, though this is unlikely until after the annual holidays, which are now only a week away in the Midland area. Activity in the heavy engineering equipment market is maintained. Important overseas contracts are keeping Midland works busy. Demand for heavy steel plate has kept up very much better than for other steel products. The re-rolling firms are still short of work.

While unemployment in the country as a whole fell last month for the first time for 11 months, it rose by 1,500 in the Midlands, from 30,577 on May 12 to 32,033 on June 16. The biggest increase has been in metal manufacture, although this applied largely to steel and there was no indication of any change in the non-ferrous industry. The non-ferrous industry continues to be quiet. Customers are still not stocking and stocks held are low. The increase in the copper price on the announcement that America was to restart stockpiling has had little effect on trade, and there has been no evidence of customers building up stocks in anticipation of further price increases. The slight falling back in price is regarded as a justification of a cautious policy.

New York

A lower lead price and a continued split in the copper producer price were the noteworthy developments in the U.S. non-ferrous metals market during last week. The easiness in lead and the firming tendency in copper (custom smelters raised their price half a cent to 26 cents); Phelps Dodge raised electrolytic copper by 1½ cents to 26½ cents) partly represented trade reaction to the mineral legislation proposed by the Senate Interior Committee. This committee had rejected U.S. Government stockpiling of lead and zinc, but had approved the Seaton proposal for stockpiling 150,000 tons of copper over a period of one year.

The lead-zinc industry was discouraged by the rejection of the stockpiling proposal, and with lead sales depressed, in order to encourage business, the price was reduced and fell half a cent to 11 cents New York.

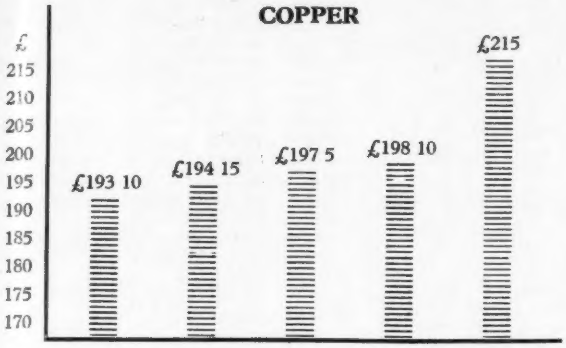
Prime Western zinc held at 10 cents per lb. East St. Louis basis, reflecting a moderate to fair demand for that grade and a better statistical position than in lead. However, traders said that in view of the rejection of zinc stockpiling—and unless some help was given to zinc producers soon, either by passage of the Seaton subsidy Bill or a higher import duty on zinc—the zinc price was expected to weaken. Special high-grade premiums had been quietly cut, traders said, in order to move this more expensive grade.

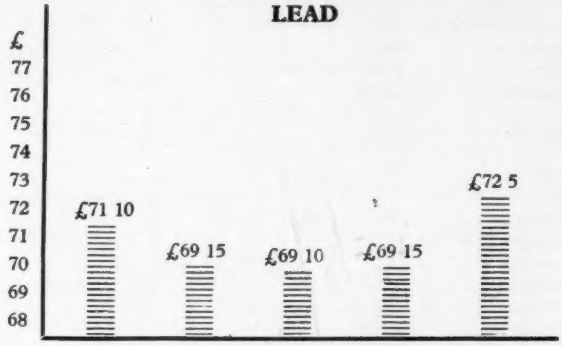
In copper, Kennecott was the only major copper producer selling at 25 cents, and informed sources said that at this level, Kennecott was garnering most of the sales. These sources said independent fabricators who were selling copper products on basis of 25 cents copper were buying their copper from Kennecott. Traders were wondering how long the three-way copper price would continue and which side would win. The answer seemed to lie in the fate of stockpile legislation, the effect of the 1·7 cents per lb. tariff re-imposed on July 1 and the future pricing policies of the independent fabricators.

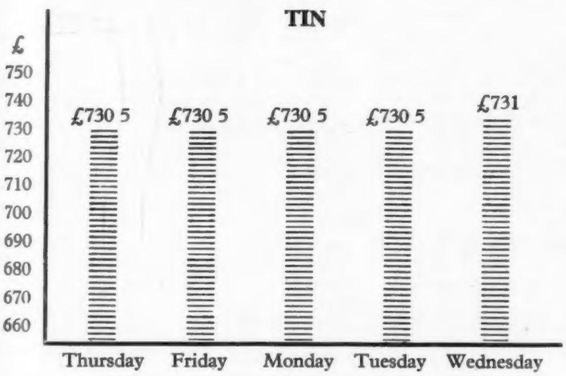
Tin was easier and quiet. Russian selling continued in London and this caused a lower price trend here. Consumers were inactive.

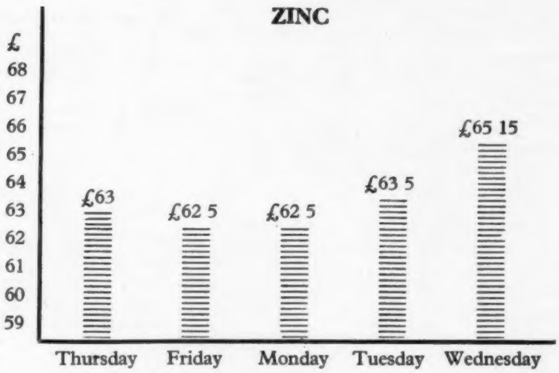
METAL PRICE CHANGES

LONDON METAL EXCHANGE, Thursday 10 July 1958 to Wednesday 16 July 1958









OVERSEAS PRICES

Latest available quotations for non-ferrous metals with approximate sterling equivalents based on current exchange rates

	Belgium fr/kg ≏ £/ton		Canada c/lb ≏ £/ton		France fr/kg ≏ £/ton		Italy lire/kg ≏ £/ton		Switzerland fr/kg ≏ £/ton		United States c/lb ≏ £/ton	
Aluminium			22.50	185 17 6	210	182 15	375	217 10			26.10	208 17 6
Antimony 99.0					195	169 12 6	430	249 10			29.00	232 0
Cadmium					1,500	1,305 0					155.00	1,240 0
Copper												
Crude												
Wire bars 99.9							390	226 5				
Electrolytic	27.50	201 0	24.00	198 5	250	217 10			2.30	192 7 6	25.00	200 0
Lead			10.75	88 15	110	95 15	179	103 17 6	.93	77 15	11.00	88 0
Magnesium												
Nickel			70.00	578 5	1,205	1,048 7 6	1,300	754 0	7.80	652 5	74.00	592 0
Tin	102.00	745 10 6			896	779 10	1,400	812 0	8.60	719 2 6	93.87	751 0
Zinc												
Prime western			10.00	82 12 6							10.00	80 0
High grade 99.95			10.60	87 10 0								
High grade 99.99			11.00	90 5								
Thermic					107.12	93 2 6						
Electrolytic					115.12	100 2 6	157	91 0 0	.82	68 10	11.25	90 0

NON-FERROUS METAL PRICES

(All prices quoted are those available at 12 noon 16/7/58)

PRIMARY METALS

		£	s.	d.
Aluminium Ingots	ton	180	0	0
Antimony 99·6%	„	197	0	0
Antimony Metal 99%	„	190	0	0
Antimony Oxide	„	180	0	0
Antimony Sulphide Lump	„	190	0	0
Antimony Sulphide Black Powder	„	205	0	0
Arsenic	„	400	0	0
Bismuth 99·95%	lb.		16	0
Cadmium 99·9%	„		10	0
Calcium	„	2	0	0
Cerium 99%	„	16	0	0
Chromium	„		6	11
Cobalt	„		16	0
Columbite	per unit		—	
Copper H.C. Electro	ton	215	0	0
Fire Refined 99·70%	„	214	0	0
Fire Refined 99·50%	„	213	0	0
Copper Sulphate	„	70	0	0
Germanium	grm.		—	
Gold	oz.	12	10	7½
Indium	„		10	0
Iridium	„	22	0	0
Lanthanum	grm.		15	0
Lead English	ton	72	5	0
Magnesium Ingots	lb.		2	5¼
Notched Bar	„		2	10¼
Powder Grade 4	„		6	3
Alloy Ingot, A8 or AZ91	„		2	8
Manganese Metal	ton	300	0	0
Mercury	flask	78	0	0
Molybdenum	lb.	1	10	0
Nickel	ton	600	0	0
F. Shot	lb.		5	5
F. Ingot	„		5	6
Osmium	oz.		nom.	
Osmiridium	„		nom.	
Palladium	„	5	15	0
Platinum	„	25	0	0
Rhodium	„	40	0	0
Ruthenium	„	16	0	0
Selenium	lb.		nom.	
Silicon 98%	ton		nom.	
Silver Spot Bars	oz.		6	3
Tellurium	lb.		15	0
Tin	ton	731	0	0
***Zinc**				
Electrolytic	ton		—	
Min 99·99%	„		—	
Virgin Min 98%	„	65	13	9
Dust 95/97%	„	104	0	0
Dust 98/99%	„	110	0	0
Granulated 99+%	„	90	13	9
Granulated 99·99+%	„	103	10	0

**Duty and Carriage to customers' works for buyers' account.*

INGOT METALS

Aluminium Alloy (Virgin)		£	s.	d.
B.S. 1490 L.M.5	ton	210	0	0
B.S. 1490 L.M.6	„	202	0	0
B.S. 1490 L.M.7	„	216	0	0
B.S. 1490 L.M.8	„	203	0	0
B.S. 1490 L.M.9	„	203	0	0
B.S. 1490 L.M.10	„	221	0	0
B.S. 1490 L.M.11	„	215	0	0
B.S. 1490 L.M.12	„	223	0	0
B.S. 1490 L.M.13	„	216	0	0
B.S. 1490 L.M.14	„	224	0	0
B.S. 1490 L.M.15	„	210	0	0
B.S. 1490 L.M.16	„	206	0	0
B.S. 1490 L.M.18	„	203	0	0
B.S. 1490 L.M.22	„	210	0	0

		£	s.	d.
†Aluminium Alloy (Secondary)				
B.S. 1490 L.M.1	ton	150	10	0
B.S. 1490 L.M.2	„	157	10	0
B.S. 1490 L.M.4	„	177	10	0
B.S. 1490 L.M.6	„	192	10	0

†Average selling prices for May

		£	s.	d.
***Aluminium Bronze**				
BSS 1400 AB.1	ton	197	0	0
BSS 1400 AB.2	„		—	
***Brass**				
BSS 1400-B3 65/35	„	136	0	0
BSS 249	„		—	
BSS 1400-B6 85/15	„	185	0	0
***Gunmetal**				
R.C.H. 3/4% ton	ton		—	
(85/5/5/5)	„	165	0	0
(86/7/5/2)	„	176	0	0
(88/10/2/1)	„	224	0	0
(88/10/2/½)	„	234	0	0
Manganese Bronze				
BSS 1400 HTB1	„	174	0	0
BSS 1400 HTB2	„		—	
BSS 1400 HTB3	„		—	
Nickel Silver				
Casting Quality 12%	„		nom.	
„ „ 16%	„		nom.	
„ „ 18%	„		nom.	
***Phosphor Bronze**				
2B8 guaranteed A.I.D. released	„	249	0	0
Phosphor Copper				
10%	„	218	0	0
15%	„	226	0	0

**Average prices for the last week-end.*

		£	s.	d.
Phosphor Tin				
5%	ton		—	
Silicon Bronze				
BSS 1400-SB1	„		—	
Solder, soft, BSS 219				
Grade C Tinmans	„	343	6	0
Grade D Plumbers	„	277	3	0
Grade M	„	376	6	0
Solder, Brazing, BSS 1845				
Type 8 (Granulated)	lb.		—	
Type 9 „	„		—	
Zinc Alloys				
Mazak III	ton	96	15	0
Mazak V	„	100	15	0
Kayem	„	106	15	0
Kayem II	„	112	15	0
Sodium-Zinc	lb.		2	5¼

SEMI-FABRICATED PRODUCTS

Prices of all semi-fabricated products vary according to dimensions and quantities. The following are the basis prices for certain specific products.

Aluminium		£	s.	d.
Sheet 10 S.W.G.	lb.		2	8
Sheet 18 S.W.G.	„		2	10
Sheet 24 S.W.G.	„		3	1
Strip 10 S.W.G.	„		2	8
Strip 18 S.W.G.	„		2	9
Strip 24 S.W.G.	„		2	10½
Circles 22 S.W.G.	„		3	2
Circles 18 S.W.G.	„		3	1
Circles 12 S.W.G.	„		3	0
Plate as rolled	„		2	7½
Sections	„		3	1½
Wire 10 S.W.G.	„		2	11
Tubes 1 in. o.d. 16 S.W.G.	„		4	0

		£	s.	d.
Aluminium Alloys				
BS1470. HS10W.	lb.			
Sheet 10 S.W.G.	„		3	0½
Sheet 18 S.W.G.	„		3	3
Sheet 24 S.W.G.	„		3	10½
Strip 10 S.W.G.	„		3	0½
Strip 18 S.W.G.	„		3	2
Strip 24 S.W.G.	„		3	10
BS1477 HP30M.				
Plate as rolled	„		2	10½
BS1470. HC15WP.				
Sheet 10 S.W.G.	lb.		3	6½
Sheet 18 S.W.G.	„		4	0½
Sheet 24 S.W.G.	„		4	10½
Strip 10 S.W.G.	„		3	9½
Strip 18 S.W.G.	„		4	0½
Strip 24 S.W.G.	„		4	8
BS1477. HPC15WP.				
Plate heat treated	„		3	5½
BS1475. HG10W.				
Wire 10 S.W.G.	„		3	9½
BS1471. HT10WP.				
Tubes 1 in. o.d. 16 S.W.G.	„		4	11
BS1476. HE10WP.				
Sections	„		3	1
Beryllium Copper				
Strip	„	1	4	11
Rod	„	1	1	6
Wire	„	1	4	9
Brass Tubes	„		1	6⅞
Brazed Tubes	„		—	
Drawn Strip Sections	„		—	
Sheet	ton		—	
Strip	„	219	0	0
Extruded Bar	lb.		1	9¼
Extruded Bar (Pure Metal Basis)	„		—	
Condenser Plate (Yellow Metal)	ton	157	0	0
Condenser Plate (Naval Brass)	„	167	0	0
Wire	lb.		2	4⅜
Copper Tubes	lb.		1	11⅛
Sheet	ton	224	5	0
Strip	„	224	5	0
Plain Plates	„		—	
Locomotive Rods	„		—	
H.C. Wire	„	245	5	0
Cupro Nickel				
Tubes 70/30	lb.		3	3½
Lead Pipes (London)	ton	110	0	0
Sheets (London)	„	107	15	0
Tellurium Lead	„	£6 extra		
Nickel Silver				
Sheet and Strip 7%	„		3	3¼
Wire 10%	„		3	10¼
Phosphor Bronze				
Wire	„		3	8¼

Titanium (1,000 lb. lots)			
Billet over 4" dia.-18" dia.	lb.	63/-	64/-
Rod 4" dia. - ·250" dia.	„	75/-	112/-
Wire under ·250" diam. - ·036" diam.	„	146/-	222/-
Sheet 8'×2'×·250"-·010" thick	„	88/-	157/-
Strip ·048"-·003" thick	„	100/-	350/-
Tube (representative gauge)	„		300/-
Extrusions	„		120/-

		£	s.	d.
Zinc Sheets, English destinations	ton	96	15	0
Strip	„		nom.	

Financial News

Metal Statistics

Detailed figures of the consumption and output of non-ferrous metals for the month of May, 1958, have been issued by the British Bureau of Non-Ferrous Metal Statistics, as follow in long tons:—

COPPER	Gross Weight	Copper Content
Wire	24,995	24,650
Rods, bars and sections	11,129	7,461
Sheet, strips and plate	11,725	9,357
Tubes	7,317	6,637
Castings and miscellaneous	6,891	—
Sulphate	1,941	—
	63,998	54,233

Of which:

Consumption of Virgin Copper	43,571
Consumption of Copper and Alloy Scrap (Copper Content)	10,662

ZINC	
Galvanizing	6,955
Brass	7,628
Rolled Zinc	2,256
Zinc Oxide	2,182
Zinc Die-casting alloy	3,744
Zinc Dust	893
Miscellaneous Uses	921
Total, All Trades	24,579

Of which:

High purity 99·99 per cent	3,922
Electrolytic and high grade 99·95 per cent	4,777
Prime Western, G.O.B. and debased	8,782
Remelted	473
Scrap Brass and other Cu alloys	3,630
Scrap Zinc, alloys and residues	2,781

ANTIMONY	
Batteries	104
Other Antimonial Lead	52
Bearings	29
Oxides—for White Pigments	118
Oxides—other	86
Miscellaneous Uses	18
Sulphides	6
Total Consumption	413

Antimony in Scrap	
For Antimonial Lead	342
For Other Uses	11
Total Consumption	353

LEAD	
Cables	8,644
Batteries	2,466
Battery Oxides	2,197
Tetra Ethyl Lead	1,570
Other Oxides and Compounds	2,499
White Lead	753
Shot	453
Sheet and Pipe	5,648
Foil and Collapsible Tubes	354
Other Rolled and Extruded	463
Solder	1,167
Alloys	1,620
Miscellaneous Uses	1,005
Total	28,839

CADMIUM	
Plating Anodes	33·70
Plating Salts	7·10
Alloys: Cadmium Copper	3·85
Alloys: Other	3·30
Batteries: Alkaline	6·90
Batteries: Dry	0·35
Solder	4·85
Colours	18·10
Miscellaneous Uses	1·25
Total Consumption	79·40

TIN	
Tinplate	778
Tinning:	
Copper Wire	40
Steel Wire	8
All other	59
Solder	135
Alloys	428
Foil and Collapsible Tubes, etc.	50
Tin Compounds and Salts	75
Miscellaneous Uses	10
Total Consumption	1,583

Keith Blackman Ltd.

Group profit year to March 31, 1958, £425,003 (£342,239), and dividend 17½ per cent (15). Current assets £1,869,458 (£1,731,178), and liabilities £397,751 (£423,924). Reserves £1,018,431 (£857,378), including £179,600 (£144,000) future tax. Commitments £24,000.

Associated Lead Manufacturers

Net profit, 1957, is £478,018 (£426,053) after tax of £457,335 (£626,980), etc. Dividend absorbs £450,000 (same). Forward £304,085 (£276,067).

Zinc Alloy Rust-Proofing Co.

Group trading profit, etc., year to April 30, 1958, £115,725 (£129,551), and net profit £40,287 (£47,791). Dividend is 27 per cent on £150,000 (40 per cent on £100,000). Fixed assets £130,541 (£111,862). Investments £38,890 (same). Current assets £196,727 (£202,884), liabilities £65,556 (£66,637). Future tax £82,383 (£86,186).

Bilston Foundries

Net profit, year to March 31, 1958, £129,421 (£101,996) and dividend 15 per cent (same). Fixed assets £834,193 (£527,742), current £432,045 (£603,423). Liabilities £279,863 (£262,486), future tax £55,000 (£80,500). Reserves £316,378 (£223,182). Commitments £45,000 (£325,000).

Scrap Metal Prices

Merchants' average buying prices delivered, per ton, 15/7/58.

Aluminium	£
New Cuttings	134
Old Rolled	110
Segregated Turnings	90
Brass	
Cuttings	123
Rod Ends	120
Heavy Yellow	105
Light	100
Rolled	115
Collected Scrap	101
Turnings	114
Copper	
Wire	168
Firebox, cut up	164
Heavy	160
Light	155
Cuttings	168
Turnings	152
Braziery	132

Gunmetal	£
Gear Wheels	162
Admiralty	162
Commercial	136
Turnings	131
Lead	
Scrap	62
Nickel	
Cuttings	—
Anodes	420
Phosphor Bronze	
Scrap	136
Turnings	131
Zinc	
Remelted	54
Cuttings	41
Old Zinc	31

The latest available scrap prices quoted on foreign markets are as follow. (The figures in brackets give the English equivalents in £1 per ton):—

West Germany (D-marks per 100 kilos):		
Used copper wire	(£169.12.6)	195
Heavy copper	(£165.7.6)	190
Light copper	(£148.0.0)	170
Heavy brass	(£108.15.0)	125
Light brass	(£82.12.6)	95
Soft lead scrap	(£61.0.0)	70
Zinc scrap	(£34.17.6)	40
Used aluminium unsorted	(£87.0.0)	100

France (francs per kilo):		
Copper	(£208.17.6)	240
Heavy copper	(£208.17.6)	240
Light brass	(£143.10.0)	165
Zinc castings	(£65.5.0)	75
Lead	(£82.12.6)	95
Tin	(£565.10.0)	650
Aluminium	(£117.10.0)	135

Italy (lire per kilo):		
Aluminium soft sheet clippings (new)	(£191.10.0)	330
Aluminium copper alloy	(£113.2.6)	195
Lead, soft, first quality	(£84.12.6)	146
Lead, battery plates	(£49.17.6)	86
Copper, first grade	(£188.10.0)	325
Copper, second grade	(£177.0.0)	305
Bronze, first quality machinery	(£188.10.0)	325
Bronze, commercial gunmetal	(£159.10.0)	275
Brass, heavy	(£130.10.0)	225
Brass, light	(£119.0.0)	205
Brass, bar turnings	(£127.12.6)	220
New zinc sheet clippings	(£55.2.6)	95
Old zinc	(£40.12.6)	70

THE STOCK EXCHANGE

Widespread Fall In Prices Owing To Middle East Situation

ISSUED CAPITAL ●	AMOUNT OF SHARE	NAME OF COMPANY	MIDDLE PRICE 15 JULY	+RISE —FALL	DIV. FOR LAST FIN. YEAR	DIV. FOR PREV. YEAR	DIV. YIELD	1958 HIGH	1958 LOW	1957 HIGH	1957 LOW
£	£				Per cent	Per cent					
4,435,792	1	Amalgamated Metal Corporation ...	20/9	+3d.	9	10	8 13 6	21/3	17/9	28/3	18/–
400,000	2/–	Anti-Attrition Metal	1/6		4	8½	5 6 9	1/6	1/3	2/6	1/6
33,639,483	Stk. (£1)	Associated Electrical Industries ...	50/–		15	15	6 0 0	51/–	47/–	72/3	47/9
1,590,000	1	Birfield Industries	52/–	+1/–	15	15	5 15 6	53/9	46/3	70/–	48/9
3,196,667	1	Birmid Industries	68/9	+1/6	17½	17½	5 2 0	68/9	56/3	80/6	55/9
5,630,344	Stk. (£1)	Birmingham Small Arms	27/3	—1½d.	10	8	7 6 9	28/6	23/9	33/–	21/9
203,150	Stk. (£1)	Ditto Cum. A. Pref. 5%	15/4½		5	5	6 10 0	15/7½	14/7½	16/–	15/–
350,580	Stk. (£1)	Ditto Cum. B. Pref. 6%	16/7½		6	6	7 4 3	17/–	16/6	19/–	16/6
500,000	1	Bolton (Thos.) & Sons	25/–		12½	12½	10 0 0	28/9	25/–	30/3	28/9
300,000	1	Ditto Pref. 5%	15/6		5	5	6 9 0	16/–	15/3	16/9	14/3
160,000	1	Booth (James) & Co. Cum. Pref. 7%	19/4½		7	7	7 4 6	19/4½	19/–	22/3	18/9
9,000,000	Stk. (£1)	British Aluminium Co.	44/9	—3d.	12	12	5 7 3	46/6	37/–	72/–	38/3
1,500,000	Stk. (£1)	Ditto Pref. 6%	19/–		6	6	6 6 3	19/3	18/4½	21/6	18/–
15,000,000	Stk. (£1)	British Insulated Callender's Cables	42/6	—9d.	12½	12½	5 13 6	45/6	38/9	55/–	40/–
17,047,166	Stk. (£1)	British Oxygen Co. Ltd., Ord. ...	33/9	—6d.	10	10	5 18 6	35/3	29/–	39/–	29/6
600,000	Stk. (5/–)	Canning (W.) & Co.	20/–		25+*2½C	25	6 5 0	21/–	19/7½	24/6	19/3
60,484	1/–	Carr (Chas.)	1/9		25	25	10 0 0X	2/3	1/9	3/6	2/1½
150,000	2/–	Case (Alfred) & Co. Ltd.	4/1½		25	25	12 2 6	4/9	4/1½	4/6	4/–
555,000	1	Clifford (Chas.) Ltd.	19/–	+1/–	10	10	10 10 6	19/–	16/–	20/6	15/9
45,000	1	Ditto Cum. Pref. 6%	15/9		6	6	7 12 6	15/10½	15/7½	17/6	16/–
250,000	2/–	Coley Metals	2/9		20	25	14 11 0	4/6	2/9	5/7½	3/9
8,730,596	1	Cons. Zinc Corp.†	47/9	+3d.	18¾	22½	7 17 3	51/6	42/6	92/6	49/–
1,136,233	1	Davy & United	52/3	+1/–	15	12½	5 14 9	52/3	45/9	60/6	42/6
2,750,000	5/–	Delta Metal	19/3	—1/3	30	*17½	7 15 9	21/4½	17/7½	28/6	19/–
4,160,000	Stk. (£1)	Enfield Rolling Mills Ltd.	34/–	+6d.	12½	15B	7 7 0	34/–	24/–	38/6	25/–
750,000	1	Evered & Co.	27/6xcap		15Z	15	7 5 6	28/3	26/–	52/9	42/–
18,000,000	Stk. (£1)	General Electric Co.	32/4½		12½	14	7 2 3Y	38/7½	29/6	59/–	38/–
1,500,000	Stk. (10/–)	General Refractories Ltd.	31/3		20	17½	6 8 0	33/9	27/3	37/–	26/9
401,240	1	Gibbons (Dudley) Ltd.	63/–		15	15	4 15 3	66/3	63/–	71/–	53/–
750,000	5/–	Glacier Metal Co. Ltd.	5/6	—3d.	11½	11½	10 9 3	6/6	5/6	8/1½	5/10½
1,750,000	5/–	Glynwed Tubes	14/–	—1½d.	20	20	7 2 9	14/1½	12/10½	18/–	12/6
5,421,049	10/–	Goodlass Wall & Lead Industries ...	23/9	—9d.	13‖	18Z	5 9 6	24/6	19/3	37/3	28/9
342,195	1	Greenwood & Batley	49/3	+6d.	20	17½	8 2 6	49/3	45/–	50/–	46/–
396,000	5/–	Harrison (B'ham) Ord.	13/6	+1½d.	*15	*15	5 11 0	13/6	11/6	16/9	12/4½
150,000	1	Ditto Cum. Pref. 7%	19/–	+3d.	7	7	7 7 3	19/–	18/9	22/3	18/7½
1,075,167	5/–	Heenan Group	7/3	—3d.	10	20‡	6 18 0	7/7½	6/9	10/4½	6/9
216,531,615	Stk. (£1)	Imperial Chemical Industries ...	27/7½xcap	—10½d.	12Z	10	5 15 9	30/4½	27/7½	46/6	36/3
33,708,76[illegible]	Stk (£1)	Ditto Cum. Pref. 5%	16/3	—3d.	5	5	6 3 0	17/1½	16/–	18/6	15/6
14,584,025	**	International Nickel	138	—5½	$3.75	$3.75	4 17 0	148½	132¾	222	130
430,000	5/–	Jenks (E. P.), Ltd.	7/9	—1½d.	27½φ	27½	8 17 6	8/3	6/9	18/10½	15/1½
300,000	1	Johnson, Matthey & Co. Cum. Pref. 5%	16/3		5	5	6 3 0	16/3	15/–	17/–	14/6
3,987,435	1	Ditto Ord.	37/6	—6/6	10	10	5 6 9	44/–	37/6	58/9	40/–
600,000	10/–	Keith, Blackman	20/–		17½	15	8 15 0	20/–	15/–	21/9	15/–
160,000	4/–	London Aluminium	4/3		10	10	9 8 3	4/4½	3/–	6/9	3/6
2,400,000	1	London Elec. Wire & Smith's Ord. ...	45/–	+3d.	12½	12½	5 11 0	45/–	39/9	54/6	41/–
400,000	1	Ditto Pref.	23/3		7½	7½	6 9 0	23/3	22/3	25/3	21/9
765,012	1	McKechnie Brothers Ord.	34/–		15	15	8 16 6	35/–	32/–	48/9	37/6
1,530,024	1	Ditto A Ord.	33/–		15	15	9 1 9	33/–	30/–	47/6	36/–
1,108,268	5/–	Manganese Bronze & Brass	9/6		20	27½‡	10 10 6	10/6	9/–	21/10½	7/6
50,628	6/–	Ditto (7½% N.C. Pref.)	5/9	—3d.	7½	7½	7 16 6	6/3	5/9	6/6	5/–
13,098,855	Stk. (£1)	Metal Box	54/3	+1/6	11	11	4 1 3	54/3	41/9	59/–	40/3
415,760	Stk. (2/–)	Metal Traders	7/1½		50	50	14 0 9	7/1½	6/3	8/–	6/3
160,000	1	Mint (The) Birmingham	19/–		10	10	10 10 6	22/9	19/–	25/–	21/6
80,000	5	Ditto Pref. 6%	79/6		6	6	7 11 0	83/6	79/6	90/6	83/6
3,705,670	Stk. (£1)	Morgan Crucible A	38/–	+6d.	10	10	5 5 3	40/–	34/–	54/–	35/–
1,000,000	Stk. (£1)	Ditto 5½% Cum. 1st Pref. ...	17/3		5½	5½	6 7 6	17/3	17/–	19/3	16/–
2,200,000	Stk. (£1)	Murex	54/–	—1/9	20	20	7 8 3	58/9	53/3	79/9	57/–
468,000	5/–	Ratcliffs (Great Bridge)	8/6	—1½d.	10	10	5 17 9	8/7½	6/10½	8/–	6/10½
234,960	10/–	Sanderson Bros. & Newbould ...	24/6	—1/3	20	27½D	8 3 3	27/–	24/6	41/–	24/9
1,365,000	Stk. (5/–)	Serck	13/4½	—3d.	17½Z	15	4 7 3	13/7½	11/–	18/10½	11/6
600,400	Stk. (£1)	Stone (J.) & Co. (Holdings)	54/–	+2/–	18	16	6 13 3	54/–	43/9	57/6	43/9
600,000	1	Ditto Cum. Pref. 6½%	23/6	+3/3	6½	6½	5 10 9	23/6	19/6	21/9	18/9
14,494,862	Stk. (£1)	Tube Investments Ord.	54/9	—6d.	15	15	5 9 6	55/9	48/4½	70/9	50/6
41,000,000	Stk. (£1)	Vickers	30/–	+1½d.	10	10	6 13 3	32/6	28/9	46/–	29/–
750,000	Stk. (£1)	Ditto Pref. 5%	15/–		5	5	6 13 3	15/6	14/9	18/–	14/–
6,863,807	Stk. (£1)	Ditto Pref. 5% tax free	21/9		*5	*5	7 2 6A	23/–	21/3	24/9	20/7½
2,200,000	1	Ward (Thos. W.), Ord.	79/–	+2/3	20	15	5 1 3	79/–	70/9	83/–	64/–
2,666,034	Stk. (£1)	Westinghouse Brake	38/3	—3d.	10	18P	5 4 6	40/–	32/6	85/–	29/1½
225,000	2/–	Wolverhampton Die-Casting ...	7/3	+1½d.	25	40	6 18 0	8/–	7/1½	10/1½	7/–
591,000	5/–	Wolverhampton Metal	17/9		27½	27½	7 15 0	18/–	14/9	22/3	14/9
78,465	2/6	Wright, Bindley & Gell	3/6		20	17½E	14 5 9	3/9¾	3/3	3/9	2/7½
124,140	1	Ditto Cum. Pref. 6%	11/6	+3d.	6	6	10 8 9	11/6	11/3	12/6	11/3
150,000	1/–	Zinc Alloy Rust Proof	3/–	—1½d.	27	40D	9 0 0	3/1½	2/7½	5/–	2/9

*Dividend paid free of Income Tax. †Incorporating Zinc Corpn. & Imperial Smelting **Shares of no Par Value. ‡ and 100% Capitalized issue. ●The figures given relate to the issue quoted in the third column. A Calculated on £7 14 6 gross. Y Calculated on 11½% dividend. ‖Adjusted to allow for capitalization issue. E for 15 months. P and 100% capitalized issue, also "rights" issue of 2 new shares at 35/– per share for £3 stock held. D and 50% capitalized issue. Z and 50% capitalized issue. B equivalent to 12½% on existing Ordinary Capital after 100% capitalized issue. φ And 100% capitalized issue. X Calculated on 17½%. C Paid out of Capital Profits.